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Volume IV, 1943

Vasco M. Tanner, *Editor*

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Vasco M. Tanner, *Editor*

C. Lynn Hayward, *Assistant Editor*

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A STUDY OF THE SUBTRIBE HYDRONOMI WITH A DESCRIPTION OF NEW SPECIES, (CURCULIONIDAE) STUDY NO. VI[1]

VASCO M. TANNER
Professor of Zoology and Entomology
Brigham Young University

At the outset of this study only species of the Hydronomi were considered which are found in the western United States, territory not covered by Blatchley and Leng.[2] As the study progressed it was found advisable to deal with all the species of America north of Mexico known to exist at the time of this writing. Eleven genera and fifty-three species are now included in the Hydronomi; nine of these species are being described as new in this study. Several of the genera are monotypic. One of these, *Lissorhoptrus simplex,* upon the basis of the larval structures, is set up as a subfamily—Lissorhoptrinae by Böving and Craighead.[3] The female genitalia of this species differs from other species of this subtribe, Figure 18. The coxites are small and no trace of the styli can be found even when the genitalia are mounted in glycerine and studied with the compound microscope. It is not clear to what extent the subfamily Curculioninae of Leng will be broken up as a result of biological and morphological studies. Since so little is known about the larval structures of this subtribe other than the one species mentioned above, the present generic arrangement is left unchanged. The species *Schizomicrus caecus* is not considered as belonging to the Hydronomi, but as Casey suspected it should be placed in the subfamily *Raymondionyminae* of Schenkling along with the genera *Alaocyba* and *Raymondionymus.* Through the kindness of the officials of the United States National Museum and

(1) Contribution No. 101, Department of Zoology and Entomology, Brigham Young University.
(2) Rhynchophora or Weevils of Northeastern America, 1916.
(3) Larvae of Coleoptera, 1931.

Mr. L. L. Buchanan I have been permitted to examine a paratype, one of the two known specimens of this blind weevil. It is not like any of the Erirhinini that I have studied. The following are notes made while studying the paratype specimen:

> Body slender, elongate and suboval; dark red, except the antennae which are yellowish and twice the length of the beak, the scape and funicle about equal in length. The beak is long and fairly uniform in dimensions; not as long as the prothorax. The antennae are located near the end of the beak. No eyes are evident. The legs are greatly modified and covered with a whitish pubescens. The tibiae are much expanded at the distal end; tarsi short and pubescent. Body deeply punctured, especially on the thorax and elytra but less so on the beak. Prothorax widest at the middle, being reduced at the anterior and basal regions. Length of prothorax and elytra 2.25 mm. The sternites are interesting since an apparent obsolete suture separates the first two segments which are three times the length of next three sternites. The prosternum is deeply excavated. In this respect it is similar to the *Bagous-Pnigodes* species.

Col. Casey's[4] description is good and can be relied upon according to my observations. I have not had a specimen of *Raymondionymus* for study. In agreement with Mr. Buchanan I believe that *Schizomicrus* and *Raymondionymus* are rather closely related and should be kept in the same subfamily.

THE EXTERNAL GENITALIA

The genitalia of the Hydronomi, Figures 13-39, are fairly uniform in pattern. They are more highly specialized than most of the Coleoptera genuina. The styli and coxites are the only genital structures remaining in the females; the valvifers are missing. The eighth sternite is modified by having chitinized arms which are partially fused medially and which extend back into the body in the form of a baculum. The peripheral portions of the segment is largely membraneous. The amount of chitinization which forms the arms and baculum is fairly definite for each species thus providing a specific character. In *L. simplex* the styli are missing and the coxites are largely membraneous, thus producing a highly specialized organ. This is distinctive enough to justify this species being separated, on this basis, from other members of the subtribe. Species of the genus Bagous are fairly uniform in fundamental structure but rather distinctive in specific characters. Species of Pnigodes show a relationship in their

(4) Coleopterological Notices, IV. p. 708. 1892.

genitalia, eighth segments and spermathecae. The spermathecae are structures which may be used in generic as well as specific separation of members of this subtribe. The male genitalia are of value and have been used in separating many of the species dealt with in this study.

The species of this subtribe are aquatic to semiaquatic in habit. Eggs are deposited upon and in stems and roots of aquatic plants. Some species as *L. simplex*, according to Tucker,[5] eat small holes in the roots of the rice plant and then drop the egg onto the gnawed roots. The genitalia of this species is of the type used to drop the egg rather promiscuously in contrast to Bagous and other genera of this complex which place the eggs in prepared holes in the stems or roots or glue them on the surface of the stems and underside of leaves. *Simplex* is specialized like many of the Scarabeoid series in which the coxites are the only genital structures left.[6] Many of the species of this series just drop their eggs on leaves, in small cracks in the bark or on the soil and grass of pasture land. There are many genital relationships in the species of the Scarabeoid and Cerambycoid series to which the Scolytids and Curculionids belong.

ECONOMIC IMPORTANCE AND BREEDING HABITS OF THE SUBTRIBE HYDRONOMI

This group of weevils is aquatic to semi-aquatic in habits. They feed and breed on palustral plants. The only species of economic importance, at present, is *Lissorhoptrus simplex* (Say) which is a serious pest of cultivated rice. It is widely distributed throughout the eastern United States, feeding on wild rice, arrow-head, bulrushes, water-lilies, as well as cultivated rice. Tucker reports that the larva, known as the "rice-root maggot," destroys the roots, while the adults, "rice water-weevils," feed upon the foliage of the plants. This weevil is one of the most destructive rice pests in the southern United States. Böving and Craighead have pointed out that the larvae have spiracles on the second to seventh abdominal segments which are projecting, hook-shaped and located dorsally. They live submerged between the leaves of rice and on the roots. The larvae of other Curculionids and Scolytids differ from the larvae of *L. simplex* in that the spiracles do not project and are not placed dorsally. It is not known to what extent other larvae of the Hydronomi are similar to *L. simplex*.

(5) Tucker, E. S., The Rice Water-Weevil and Methods of Its Control, U. S. D. A., Bureau of Ento., Circular No. 152, pp. 20. 1912.

(6) Tanner, Vasco M., A Preliminary Study of the Genitalia of Female Coleoptera. Transactions Am. Ent. Soc. 53: 5-50, Figs. 1-222. 1927.

Specimens of *Brachybamus electus* have been collected on the arrow-head, *Sagittaria.* It is fairly common in swamps in the northeastern United States.

Endalus limatulus is common around New York City, where it is found mainly in or near salt meadows. In Utah it has been collected by the writer on bulrushes, *Scirpus* sp., in a temporary pond, "Dry Lake," near Wellsville, Cache Co., in June. I have also collected it along the shore of Utah Lake, in Utah Co., on *Scirpus acutus;* and at St. George, Washington Co., in alkali swamps on *Scirpus acutus* and *Typha latifolia. E. punctatus* has been taken on sweet fern or marshy plants around New York City; while *E. laticollis* lives on swampy plants and on vegetation around the shores of ponds.

Tanysphyrus lemnae breeds in ponds and lakes on various species of the duck-weed, *Lemna,* the leaves of which the beetle perforates with round holes. It probably occurs wherever *Lemna* grows. This is an introduced species from Europe.

Onychylis nigrirostris breeds on the arrow-head, *Sagittaria,* while the adults have been collcted in large numbers on the flowers of the pickerel-weed, *Pontcderia cordata. O. angustus* feeds on the arrowhead.

Lixellus filiformis was collected by the writer on *Scirpus* sp. in "Dry Lake" near Wellsville, Cache Co., Utah, in June, 1937.

Species of the genus Bagous have been found to feed and breed rather widely on the aquatic plants of this country. *B. magister,* the largest species of this genus, has been collected on water-lilies in New Jersey. *B. cavifrons, B. maculatus* and *B. bituberosus* have been found to feed on several pond and marsh plants. *B. chandleri* have been found on sedge, *Carex* sp. in small ponds along the shore of Utah Lake. At Havee, Montana is was found on *Elcocharis palustris. B. texanus* was collected on *Cyporus virens* Michx. at Victoria, Texas. *B. tingi* was apparently feeding and breeding on *Potamogeton panormitanus* in Lake Pilarcitos, California, according to Mr. Peter Ting who collected several specimens.

The species *Pnigodes buchanani* was collected on *Ptilimnium capillaceum* (Michx.) in May, at Opelouses, Louisiana. *P. setosus* has been found breeding in the roots of *Lepidium* sp. at Calvert, Texas.

LOCATION OF THE AMERICAN TYPES OF BAGOUS

Thomas Say's type of *B. mamillatus* is lost or destroyed. A neotype has been designated which is being deposited in the entomological

collections of the United States National Museum. An illustration of the plesiotype is contained in this study.

The types of the twelve species described by LeConte are in the Museum of Comparative Zoology, Harvard College, Cambridge, Massachusetts. In only three species did LeConte have several specimens in the type series. Seven of the species were represented by only a single specimen. Dr. Nathan Banks, curator of the Harvard Entomological Collections, and Mr. Floyd Werner, an assistant, have been of great assistance in this study through their identification and comments on specimens compared with the types.

Willis S. Blatchley's types of Bagous species are in the Purdue University entomological collections, with the exception of *puritanus* which is in the entomological collections of the Museum of Comparative Zoology, Harvard College. A cotype specimen of *ochraceus* is in the writer's collection at Brigham Young University. This specimen was included in a collection of several hundred species of weevils purchased from Dr. Blatchley in 1930. Dr. J. J. Davis, of Purdue University, has kindly sent to me for study purposes specimens from the type series of the following species: *maculatus, lunatus* and *blanchardi.*

The types of the seven species described in this study are being disposed of as follows: *blatchleyi, longirostrus* and *texanus* in the United States National Museum, Washington, D. C.; *floridanus* in the Museum of Comparative Zoology, Harvard College; and *lengi, chandleri* and *tingi* in the writer's collection at Brigham Young University. Paratypes of many of these species have been sent to the collections of cooperating institutions.

ACKNOWLEDGMENTS

The writer acknowledges with thanks the loan of specimens from Dr. J. J. Davis, Purdue University, Indiana; Mr. Peter C. Ting, San Francisco, California; Mr. William T. Davis of New York City; Professor Joseph Knull, University of Ohio, Columbus, Ohio; Professor Henry Dietrich, Cornell University, Ithaca, New York; Mr. Mont Cazier, American Museum, New York; Dr. Dwight Pierce, Los Angeles Museum, Los Angeles, California; Dr. Clarence Mickel, University of Minnesota, St. Paul, Minnesota; Mr. L. L. Buchanan, United States National Museum; Dr. P. J. Darlington, Dr. Nathan Bank and Mr. Floyd Werner of Harvard College, Cambridge, Massachusetts. I am especially indebted to Mr. Darlington and Mr. Werner who compared many specimens with the LeConte types and sent valuable notes

along with the specimens. Dr. Davis sent several of Dr. Blatchley's paratypes for study, and Mr. Buchanan supplied me with many determined as well as undetermined specimens from the National Museum. Dr. E. P. Van Dyke kindly permitted me to study the specimens of this group in the California Academy of Science collection.

THE SUBTRIBE HYDRONOMI

The weevils belonging to the tribe Erirhinini are divided into several subtribes. This study is concerned with the genera and species of the subtribe Hydronomi. As now constituted this subtribe consists of eleven genera, seven of which are monotypic or contain only one species in our fauna. The other genera except Bagous, contains very few species. As a result there are only fifty-three species ascribed to these genera, twenty-nine of which belong to Bagous. The species of Hydronomi live upon semi-aquatic plants, protecting their bodies with a water-proof coating which has dirt and fine sand intermixed with it. The eyes touch the thorax since the head is not prolonged behind.

A key to the genera of the subtribe Hydronomi found in North America is presented and all the known species are listed. Keys are included to help separate the species. The eleven genera may be separated as follows:

A KEY TO THE GENERA OF THE SUBTRIBE HYDRONOMI FOUND IN AMERICA NORTH OF MEXICO[7] WITH A LIST OF SPECIES AND THEIR KNOWN DISTRIBUTION

1. Metasternum as long as the first sternite; covered with a dense, varnish-like, waterproof coating of scales.....(2)
   Metasternum one-third the length of the first sternite; front coxae narrowly separated.....*Phycocoetes*
   P. testaceus Lec. So. Calif.
2. Beak very short and broad, not longer than the head; tarsi narrow, the third segment deeply emarginate.....*Stenopelmus*
   S. rufinasus Gyll., Fla.; Ind.; So. Calif.; Provo, Utah.
   Beak cylindrical, much longer than the head.....(3)
3. Third segment of hind tarsi emarginate or bilobed.....(4)
   Third segment of hind tarsi simple; legs long and slender.....(9)
4. Beak curved; funicle of six segments, the second short; third segment of tarsi broad, deeply bilobed, last segment short.....(5)
   Beak straight; second segment of funicle long, as also the last segment of the tarsi.....(8)

(7) Dr. J. C. Bradley's "Manual of the Genera of Beetles of America North of Mexico," 1930, has been drawn upon freely in the preparation of this key.

5. Tarsi with a single claw.....*Brachybamus*
B. electus Germ., Mass.; D. C.; Fla.; Ind.; N. Y.; N. J.; Va.; Ga.
Tarsi with two claws.....(6)

6. Last segment of tarsi broad, the claws well separated.....(7)
Last segment of tarsi narrow, projecting beyond the lobes of the third, the claws slender.....*Onychylis*
Elytra without rows of setae.....2
Alternate interspaces with a row of distinct setae....*alternans* Lec.
Texas.

2. Body rather stout.....*nigrirostris* (Boh.)
Fla.; Ga.; Pa.
Body more elongate.....*longulus* Lec.
Mich.; Mass.

7. Elytra but slightly if any wider than the thorax; length usually 2 mm. or more.....*Endalus*

I. Last joint of tarsi slightly prominent claws moderately large, elytra wider than the prothorax.
Scales with bristles intermixed.....*setosus* Lec.
Tex.; Kan.
Scales uniform, without bristles intermixed.....2

2. Prothorax not coarsely punctured.....3
Prothorax coarsely punctured.....4

3. Scales bronzed, beak long and slender, size 2 mm.
Scales gray, length 4 to 4.5 mm.....*acratus* Lec.
Tex.; Kan.; Id.

a. Beak shorter, stouter, flatter and scarcely curved, elytra shorter, punctation stronger, prothorax more rounding and wider.....*robustus* Schffr.
Tex.

aa. Beak longer, narrow and slightly curved; punctation less; prothorax more elongate.....*limatulus* (Gyll.)
N. Y.; R. Isl.; D. C.; Colo.; Ariz.; Nev.; Calif.; Logan, Provo and Moab, Utah.

4. Prothorax scarcely wider than long.....*cribricollis* Lec.
Prothorax transverse, constricted in front.....*punctatus* Lec.

II. Last joint of tarsi not prominent; body oval.

b. Size 1.5 to 1.7 mm. Prothorax wider, equal to the elytra. Sides rounded, coarsely punctured and impressed near apex.....*laticollis* Blatch.
Dunedin, Fla.; Cotype specimens.

bb. Size 1.8 to 2.3 mm. Prothorax not so wide, less than the elytra, surface deeply but not coarsely punctured, with three pale vittae.....*ovalis* Lec.
Ind.; N. Y.; Mont.; So. Calif.; Ridgeway, Canada.

Elytra much wider than the thorax; length less than 1.5 mm....*Tanysphyrus*
Entire body and appendages shining black in color, beak longer and more slender.....*atra* Blatch.
One specimen from Cambridge, Mass.

Body dull black, antennae and tarsi brown, beak not so long and broader.....*lemnae* (Fab.)
Pa.; N. Y.; N. J.; Mich.; Mass.; Ill.; Edmonton, Alta.; Europe; Japan. An introduced species from Europe.

8. Front and middle tibiae serrate on the inner side; third tarsal segment narrow, slightly emarginate; funicle of six segments.....*Lixellus*
L. filiformis Lec., Cypress Hills, Alta.; Boucheville, Ont., Canada; Ore.; Colo.; Nev.; Wellsville, Utah.

Tibiae not serrate within; third tarsal segment broad, deeply bilobed; funicle of seven segments.....*Anchodemus*
Scales brownish-gray, not mottled.....*angustus* Lec.
Fla.; N. Y.; Ill.; Toronto, Ont., Canada.
Scales grayish-white, not mottled.....*hubbardi* Lec.
Detroit, Mich.; Mass.
Scales brown, elytra with a paler band.....*schwarzi* Lec.
Mass.

9. Club of antennae partly smooth and shining; funicle of six segments; prosternum not excavated.....*Lissorhoptrus*
L. simplex (Say.), Fla., Texas, Va., D. C., Md., N. J., N. Y., Ia., Minn., Mo., Canada.

Club entirely pubescent and sensitive; funicle of seven segments; prosternum broadly and deeply excavated in front of coxae.....(10)

10. Pronotum feebly constricted in front.....*Bagous*
Key to species below.
Pronotum very strongly constricted and tubulate in front.....*Pnigodes*
Key to species below.

THE GENUS BAGOUS

The genus Bagous was established by Ernst F. Garmar in 1817[8] with *Rhynchaeus binodulus* Gyllenhal as the genotype. The word Bagous is Persian in origin meaning a spade or castrated animal. The species of this genus are known only from the northern hemisphere. Schoenherr in 1826[9] characterized the genus as follows:

"Antennae breviusculae, subtenues; funiculo 7 - articulato; articulis duobus basalibus elongatis, obconicis, reliquis subperfoliatis, coarctatis, versus apicem gradatim latioribus; clava ovalis, magna.

Rostrum breviusculum, arcuatum, robustum, teres.

Thorax subcylindricus, antice late emarginatus, exigue pone oculos lobatus; canalis inferus, brevis.

Elytra oblongo-ovata, versus apicem valde callosa, abdomen obtegentia; humeri obtuse angulati.

Tibiae longae, versus apicem arcuatae, apice ipso unco acuto armatae; tarsi angustati."

It will be noted that Schoenherr points out that the characteristic

(8) Magazin der Entomologie, Halle, II. 1817, p. 340.
(9) Curculionidum Dispositis Methodica. 1926. p. 289.

features of this genus are: an excavated prothorax for the reception of the rostrum; a sentitive antennal club and slender curved tibiae, armored at the distal end with a hooked spine. He also points out on page 232[10] that the genus *Hydronomus* is similar to Bagous, but lack the channeled thorax; and that these genera live on and around aquatic plants.

In discussing the weevils of the Seine Basin Louis Bedel[11], however, considered Bagous a synonym of Hydronomus. Later European workers have not followed Bedel in this but have treated Bagous as a valid genus and have ascribed to it some thirty-five to forty species.

Thomas Say described *mamillatus,* the first American species of the genus Bagous, in 1831.[12] Say was confused as to the definite characteristics of Bagous and yet he had the works of Garmer and Schoenherr referred to above. Besides the species *mamillatus* he described *simplex* = *Lissorhopterus simplex* and *aereus* = *Tyloderma aerea* as species of this same genus.

J. L. LeConte[13] presented the essential characters of this genus in 1876 and described twelve new species. In 1916 Blatchley[14] described seven new species to which he added a species in 1920[15] and another in 1925.[16] In this study seven species are described as new thus bringing the recognized American species to 29.

KEY TO AMERICAN SPECIES OF BAGOUS

A. Third joint of tarsi broader, emarginate.....1

B. Third joint of tarsi narrow, not emarginate.....4

1. Elytra each with one posterior tubercle.....2
   Elytra each with two posterior tubercles.
   a. Sides of thorax and elytra clay-yellow, elytra with an oblique strip of clay-yellow scales extending from middle of sides to white lunula at declivity. Size 3.5 mm.....*lunatus* Blatch.
   aa. Sides of thorax and elytra uniform, pale gray to grayish black with some oblique white dots; size 2.3 to 2.5 mm.....*planatus* Lec.

2. Interspaces equal, flat, or nearly so.....3
   Alternate interspaces more elevated.
   b. Third, fifth and seventh elytral interspaces largely elevated; color chestnut to blackish except a spot on declivity and tubercle which

(10) Op. Cit.
(11) Faune des Coleopteres Du Bassin De La Seine. Tome VI., 1888. p. 276.
(12) The Complete Writings of Thomas Say in the Entomology of North America. Vol. I. 1859. p. 297. J. L. LeConte Edition.
(13) The Rhynchophora of America North of Mexico. 1876. pp. 183-188.
(14) Rhynchophora or Weevils of North Eastern America. 1916. pp. 230-238.
(15) Some New Rhynchophora from Eastern North America with Additions to and Corrections of the "Rhynchophora of North Eastern America." Journal. N. Y. Ent. Soc. Vol. 28, 1920. p. 166.
(16) Notes on the Rhynchophora of Eastern North America with descripions of New Species III. Jour. N. Y. Ent. Soc., Vol. 33. 1925. p. 95.

are grayish white. Size 2.9 to 3.3 mm. in length.....*lengi* n. sp.

bb. Third, fifth and seventh interspaces largely elevated, black, but covered with lead gray coating and scales, tubercle large, size 4.2 mm. in length.....*blatchleyi* n. sp.

bbb. Third, fifth and seventh elytral interspaces only slightly elevated; lateral, apical and area around tubercle and declivity whitish; central area of disk brownish black.....*sellatus* Lec.

3. Scales in pattern or mottled.

c. Scales gray and dark brown, striae deeper, callus not very prominent .....*obliquus* Lec.

cc. Scales grayish brown with striking white scale pattern, intervals slightly convex; without callus on or near the declivity..*pictus* Blatch.

4. Elytra each with one posterior tubercle.....5
Elytra each with a tubercle at the middle and two posterior tubercles .....*mamillatus* Say.

5. Tarsi short, prothorax scarred with deep impressions.....8
Tarsi short or moderate, prothorax feebly granulate.....9
Tarsi long, prothorax finely rugose.....6
Tarsi not so long, prothorax smooth to finely punctate.....7
Tarsi very long, fourth segment longer than the second and third segments combined; prothorax granulate.....10

6. Tarsi long, fourth segment as long as second and third combined, first three segments narrow with long white setae; beak one and one-half times as long as the prothorax.....*longirostrus* n. sp.
Tarsi long, fourth segment less in length than the second and third combined, first three segments slightly broader and more setiferous than in *mamillatus;* prothorax finely rugose, beak only as long as prothorax.....*americanus* Lec.

7. Tarsi not so long, prothorax smooth; sides straight to anterior fourth then only slightly constricted; surface clothed with fine ocellate scales; femora black to rufous, size 2.8 to 3 mm.....*blanchardi* Blatch.
Tarsi shorter, third segment a little broader and slightly emarginate, intermediate in this characteristic between *planatus* and *mamillatus.* Elytral striae deeper and with regular deep punctures, mottled with whitish and brownish scales; body more robust, size 3.5 to 4.1 mm. .....*texanus* n. sp.

8. Front deeply excavated, beak tricarinate.....*cavifrons* Lec.
Front not excavated, but with fovea.

d. Front foveate, beak tricarinate, prothorax without median carina .....*magister* Lec.

dd. Front foveate, beak tricarinate, prothorax with median carina .....*carinatus* Blatch.

9. Disc of thorax without ridges and depressions, without median channel, granulate 13
Disc of thorax without ridges and depressions, with median channel, granulate.
Surface uniform black except the white cross bar near declivity....
.....*atratus* Blatch.

Surface mottled or with clouded mixture of blackish and whitish scales.

e. Size 4 mm. Elytra with small pale spots or dots, thorax coarsely granulate; front not foveate..... *maculatus* Blatch.

ee. Size 3.2 mm., mixture of black and white scales, not spotted; striae deep, interspices elevated, third interspace wider and with white spot on third and fourth interspaces behind the middle.... ..... *nebulosus* Lec.

10. Fourth tarsal segment long, claws divergent, elytra uniform in color...11
Fourth tarsal segment not so long, claws less divergent, elytra with color spots 12

11. Elytra uniform in color, beak short..... *californicus* Lec.
Elytra with some mixing of scales of different colors.

f. Size 2.5 to 2.9 mm. with white and brown patches of scales..... ..... *chandleri* n. sp.

ff. Size 3.0 to 3.1 mm., reddish in color with a white covering over the surface of a granular prothorax and elytra..... *tingi* n. sp.

12. Elytra with a white spot behind, beak short..... *restrictus* Lec.
Elytra with a cross-bar or band behind.

g. White spot at apex of declivity single, crossing the suture in the form of a small cross-bar; form very slender, size 2.5 mm..... ..... *puritanus* Blatch.

gg. Elytra with a broad black band crossing the suture behind the middle; size 1.8 mm..... *pusillus* Lec.

13. Prothorax as wide as long, beak shorter than thorax.

h. Elytra black, usually covered with dirt colored scales, their striae deep, size 3 mm..... *bituberosus* Lec.

hh. Elytra black, covered with dirt colored scales, except for small white spots before the declivity on the second and third interspaces and pale lateral stripes on the thorax; striae with deep punctures, size 3 to 3.2 mm..... *floridanus* n. sp.

hhh. Elytra with an oblique clay-yellow strip reaching from humerus to the prominent tubercle and declivity, striae fine.. *pauxillus* Blatch.

Prothorax wider than long, much constricted in front, beak as long as thorax.

i. Front with a large fovea, sides of thorax sinuate; antennae and legs nearly black..... ..... *transversus* Lec.

ii. Front without fovea; sides of thorax not sinuate; antennae and legs red..... *ochraceus* Blatch.

DISCUSSION OF THE SPECIES OF BAGOUS

Bagous lunatus Blatch., Fig. 1

Blatchley and Leng, Rhynchophora or Weevils of North Eastern America, p. 232, 1916.

Black, clothed with clay-yellow and fuscous-brown scales, the former forming a stripe along each side of the thorax and elytra; this

stripe with an oblique spur extending from basal third of elytra to a broad, lunate white spot, concave behind, which crosses the suture at apical third. Thorax as wide as long; elytra behind the humeri one-half wider than thorax; all intervals slightly convex, the third and fifth with prominent concial tubercles on and posterior to the declivity; the third tarsal segment broad and deeply marginate.

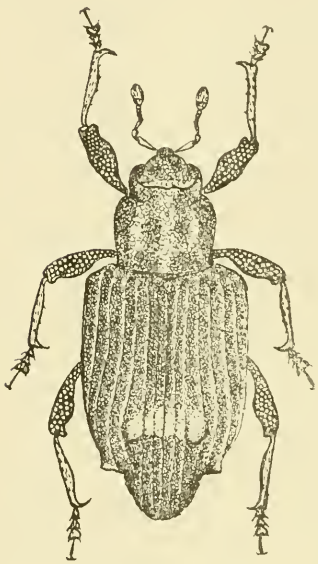

Fig. 1
Bagous lunatus Blatchley
X 13. (Original)

Size: 3.3 to 3.8 mm. in length

Distribution: Gainesville, Enterprise, Barlow, Ft. Capron, La Belle, St. Nicholas, Jacksonville, Cedar Keys, Ft. Myers, Dunedin and Lake Okeechobee, Florida; New Orleans, Louisiana.

Remarks: This is one of the most distinctive species of Group A. The large tubercles just before the declivity along with the crescent white spot and the fuscous-brown scales separates this species from others of this group.

Bagous planatus Lec., Fig. 2

LeConte, John L. and Horn, Geor. H., Rhynch. of Amer. Proc. Am. Phil. Soc. Vol. XV, p. 185, 1876.

Black, clothed with gray, approaching lead color to dark brown or black scales, with an oblique series of small whitish blue spots between the humeri and the tubercles on the declivity; prothorax also with lateral and a medial stripe of whitish-blue scales; disc granulate and feebly channeled. Beak nearly as long as the prothorax, nearly naked. Elytra wider than the prothorax, interspaces nearly flat, with a V shaped depression on the first third; the tubercles at the declivity and beyond small and covered with whitish blue scales. Antennae and feet dark testaceous; third tarsal broad and emarginate.

Size: 2.7 to 3.0 mm. in length.

Distribution: Brown Island, Charlevoix Co., Michigan; Gordon Lake, Turtle Mts., North Dakota; Houston Co., Minnesota; Portland Oregon; Washington; Olcotte, Ithaca and Penn Yan, New York; Iowa; Memence, Illinois; Washington, D. C.; Hillsdale, New Jersey; and Ft. Monroe, Virginia.

Remarks: The whitish blue spot on the fifth interval near the middle should not be mistaken for a small tubercle and thus confuse this species with *mamillatus* which has a well-developed tubercle at the middle; see Figurs 2 and 4. There has been considerable misidentification of this species. The above descriptive notes and the drawing which emphasizes the broad third tarsal segment and lack of tubercle at the middle should make possible the ready separation of this species.

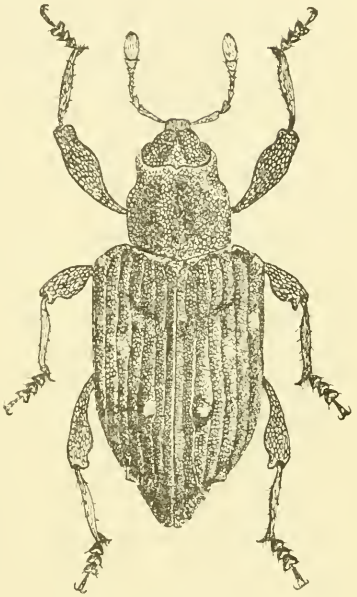

Fig. 2
Bagous planatus LeConte
X 16. (Original)

Bagous lengi Tanner, n. sp.
Fig. 3

Type female: Elongate, slender; black except antennae and tarsi that are dark red. Beak curved; apex not dilated, not as long as prothorax, smooth but with ocellate scales. Front broadly impressed and granular. Second joint of funicle about as long as two succeeding joints combined. Prothorax slightly wider than long, sides parallel, with a rounded base and broad constriction at the tip. Surface coarsely punctured with a median whitish channel. Elytra a little wider than the prothorax; humeri oblique and swollen due to the fusion of the seventh, eighth and ninth interspaces; third and fifth interspaces prominent, the fifth with a small tubercle at the declivity; tubercle and third and fourth interspaces behind the middle with white spot; surface granulate. Legs rather short and husky; tarsi short, with third segment much enlarged and emarginate; fourth segment as long as two preceding combined, claws only slightly divergent.

Size: 2.9 to 3.3 mm. in length.

Type Locality: Type specimen, one of two specimens from the Leng collection labeled "Iowa." Paratypes, eleven specimens; four from Lake Okoboji, Iowa, collected by L. L. Buchanan, June 22, 1917; three from Iowa City, Iowa, Wickham collection; one five miles east Renwick, Iowa, May 19, 1928, G. O. Hendrickson collection; and one South McAlester, Indiana; the type and three paratypes in the author's collection at Brigham Young University and eight paratypes in the United States National Museum.

Remarks: This species may be readily separated from other species with the broad third tarsal segment by the well-developed convex interspaces, granulation, slender shape and color.

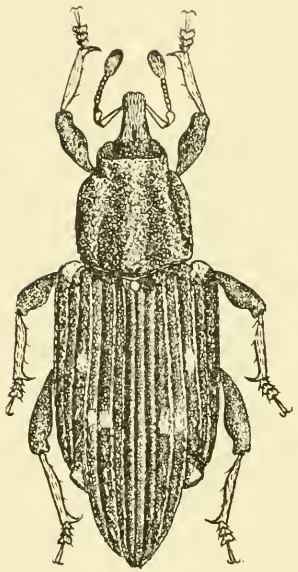

Fig. 3
Bagous lengi, New Species
X 16. (Original)

Bagous blatchleyi Tanner, n. sp.

Elongate; black with covering of lead gray coating and scales. Beak about as long as prothorax, stout, flattened at distal end, coarsely punctured; front with deep punctures and well-developed fovea. Second joint of funicle, longer than the two following joints combined. Prothorax wider than long, sides straight to near the tip where it is broadly constricted; surface granulate, covered with fine crenulated lines, a median channel and lateral median gray stripes. Elytra a third wider than the prothorax; humeri obtusely angular and prominent being composed of the coalesced ends of the seventh, eighth and ninth interspaces; third, fifth and seventh interspaces strongly convex, alternate interspaces practically flat; striae fine, punctures obscure, surface uniformly lead-gray in color; tubercle on fifth interspace prominent and pointed. Antennae, tibiae and tarsi dark reddish-brown in color; tarsi with broad, deeply emarginate third segment, fourth segment as long as the second and third combined, claws small and not divergent.

Size: 4.2 mm. in length.

Type locality: Described from a single specimen collected at Tampa, Florida, by Hubbard and Schwartz. The holotype is being deposited in the entomological collection of the United States National Museum, Washington, D. C.

Remarks: *Blatchleyi* is the largest species of Bagous in group A. The narrow convex interspaces are characteristic, being rather widely separated by flat interspaces. The color, large tubercle, wide prothorax and stout beak separates it from *lengi* its nearest relative.

Bagous sellatus Lec.

LeConte and Horn, Rhynch. 1876, p. 184.

LeConte's description of this species is as follows:

"Black; head, three thoracic vittae, sides and tip of elytra densely covered with cinereous scales, leaving a large elongate common triangular space black. Prothorax a little longer than wide, coarsely granulate, sides parallel, suddenly constricted near the tip. Elytra with the humeri oblique and obtusely angulated, striae deep, interspaces convex, first, third, and fifth more elevated, the last terminating in a large conical tuberosity, which is surrounded behind by a dark cloud. Beneath fuscous, thighs with a ring of paler scales. Tarsi with the third joint broader, emarginate."

Size: 2.4 to 2.8 mm. in length.

Distribution: Ft. Monroe, Virginia; St. Augustine, Florida; and Georgia.

Remarks: The color markings consisting of a black triangular spot on the disc of the elytra which extends from the base near the humeri, on the fifth interspace, back to the declivity and the suture as well; the lateral and medial stripes on the prothorax makes this a distinctive species.

Bagous obliquus Lec.

LeConte and Horn, Rhynch. 1876, p. 185.

Black, variegated with pale and dark-brown scales. Beak as long as the prothorax; the latter longer than wide with pale stripe. Elytra nearly one-half wider than prothorax, with an oblique pale band extending from the humerus to the suture behind the middle; other pale spots are scattered over the disc and declivity. Antennae and legs testaceous; third tarsal segment broad and emarginate.

Size: 2.3 to 2.8 mm. in length.

Distribution: Florida; Washington, D. C.; Virginia; New Jersey; New York; Minnesota; and Nebraska.

Remarks: Readily separated from other species due to the broad emarginate third tarsal segments, the color pattern, poorly developed tubercle on the declivity, and the broad thick set beak.

Bagous pictus Blatch.

Blatchley, W. S., Some New Rhynchophora from Eastern North America with additions to and corrections of the "Rhynchophora of North Eastern America." Jour. N. Y. Ento. Soc. Vol. 28, p. 166, 1920.

"Elongate-oblong. Reddish-brown, densely clothed with grayish-brown and snow-white scales, the latter forming a narrow median and a broad stripe each side of thorax, the lateral stripes forking in front of middle; the white scales on elytra covering the humeri and fifth, sixth and seventh intervals to beyond the middle; basal portion of third interval and a common spot on second and third at apical third

also white. Beak stout, as long as thorax, strongly deflected, densely scaly. Head without frontal fovea. Thorax nearly as broad as long, constricted near apex, densely granulate. Elytra oval, one-third wider than thorax, humeri oblique; intervals feebly convex, without tubercles on or near the declivity. Length, 2.8 mm."

Distribution: Cape Sable, Florida.

Remarks: I have never seen this species which was described from two specimens collected on February 24th by Dr. Blatchley. These specimens are in the Blatchley type collection at Purdue University, Lafayette, Indiana. It is the policy (with which I heartily agree) of this institution not to send out type specimens for study purposes. Because of this I have associated *pictus* with *obliquus* only because Blatchley has done so. The original description given above suggests that *pictus* may be closely related to *sellatus* both as to color pattern and lack of tubercle on the declivity. The tarsal segments of *pictus* should be carefully examined. Until the Blatchley specimens are studied this species is questionable.

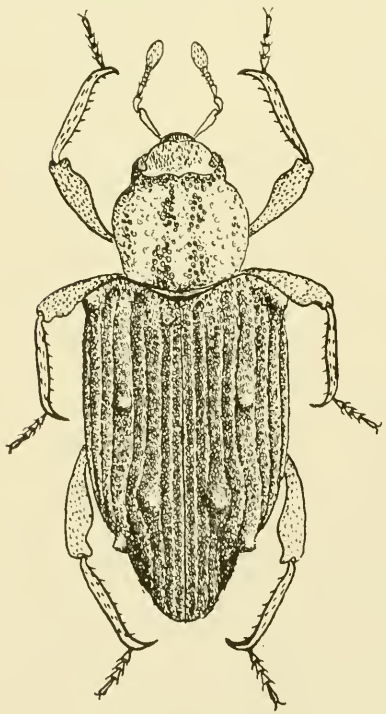

Fig. 4
Bagous mamillatus Say
X 13. (Original)

Bagous mamillatus Say
Fig. 4

1821, 28. LeConte, Editor, p. 297.

There has been a question in the minds of students of Bagous as to what species Say actually had before him when he described *mamillatus*.. The original type specimen has been destroyed, so we must rely upon his short but rather definite description of the species. It would seem that even LeConte was confused concerning the actual identity of *mamillatus* since he believed the species had a broad emarginate third tarsal segment, a character not mentioned by Say. My study of hundreds of specimens of Bagous has resulted in finding several specimens from near the type region which seem to agree almost perfectly with the original descrip-

tion. The accompanying illustration, Figure 4, is an accurate reproduction of a plesiotype specimen which I am designating as the neotype. This specimen was collected at Arkedelphia, Clark County, Arkansas, in July by H. B. Wheek. Other specimens were collected at Tallulah (July 2, 1925) and Sheveport (July 3, 1891) Louisiana; Ann Arbor (June 16, 1918), Michigan; and W. Springfield (May 27, 1895), Massachusetts.

The following is Say's description of *mamillatus:*

"Cinereous; elytra tuberculate. Inhabits Missouri. Body cinereous; elytra, each with two tubercles behind the middle, placed obliquely, a smaller one on the middle and the humerus with a small tubercle; thighs clavate; tibiae much arcuated toward the tip, and at tip acute, with rather long, rigid hair on their inner side. Length three-twentieths of an inch."

Description of the Neotype: Rather robust, black, covered with cinereous scales, except the tibiae, tarsi and antennae which are red. Beak shorter than the prothorax, faintly trisulcate, scaly, scape attachment on apical third; mouth area red. Frontal fovea not well developed; covered with dense scales, not granulate. Prothorax slightly wider than long, widest just anterior to the middle, sides straight for three-fourth the length, then rounded and only slightly constricted; finely granulate uniform in color and without a median channel. Elytra nearly one-half wider than the prothorax, humeri prominent, oblique and rounded, with a tubercle; interspaces practically flat, no rows of inclined bristles; striae shallow without obvious punctation; color uniform cinereous, except for white on tips of tubercles, and the dirty yellow coating on some specimens. A small but well developed tubercle at the middle on the fifth interspace which is in an oblique line with the tubercles on the declivity and the humeri. The apical tubercle is well developed but smaller than the one on the declivity. The legs are long, femora noticeable clavate; tibia arcuate, with an inner row of short spines and long setae; tarsi long, and narrow; fourth segment longer than the sceond and third combined; claws long and only slightly divergent. The female genitalia, Figure 20, has well developed coxites and styli which are extremely chitinized. The eighth sternite is a chitinized spatulate structure. The styli are large and well provided with sensory setae.

Size: 3.9 to 4.5 mm. in length.

Distribution: The neotype specimen is from Arkadelphia, Clark County, Arkansas. One mesothoracic leg has been broken off, but is glued to the tip which bears the specimen; the tarsi are broken off, also the meso- and metathoracic legs. The funicle is missing from

one antenna. This specimen, along with one from Tallulah, Louisiana, and one from Ann Arbor, Michigan, is being returned to the United States National Museum. Two specimens, one from W. Springfield, Massachussets, and one from Sheveport, Louisiana, are in the writer's collection at Brigham Young University. These latter two specimens are from the United States National Museum collection and we are pleased to be able to retain them.

Remarks: The determination of *mamillatus* is a great help in understanding other American species of Bagous. In the LeConte key *mamillatus* is considered to have broad third tarsal segments. According to the specimens now designated as *mamillatus* this is not the case.

Bagous longirostrus Tanner, n. sp., Fig. 5

Elongate-oblong. Rufescent, clothed uniformly with silvery-gray scales; except on the legs and beak which are sparsely covered to scaleless; prothorax larger than wide; sides straight for three-fourths, then only slightly narrowed and broadly constricted near the tip; fine punctures on the disc covered by enlarged ocellate scales. Beak one and one-half times as long as the prothorax, slightly curved and dilated, antennae inserted at middle of beak, first segment of funicle a little enlarged. Figure 5. Legs long, tibia slender and only slightly arcuate; tarsi long, fourth segment as long as the second and third combined; claws divergent; ventral surfaces of tarsi segments covered with whitish pubescence. Elytra wider than the prothorax; humeri obtuse, rounded not prominent; interspaces about equal, flat, striae shallow and punctured; only one small tubercle on the fifth interspace at the declivity. Female genitalia with well chitinized coxites, especially at the apices which bear well developed styli. The following are some measurements of the head and prothoracic parts: Beak 1.6 mm.; scape .7 mm.; prothorax 1.0 mm. and mesothoracic tarsus 1.0 mm.

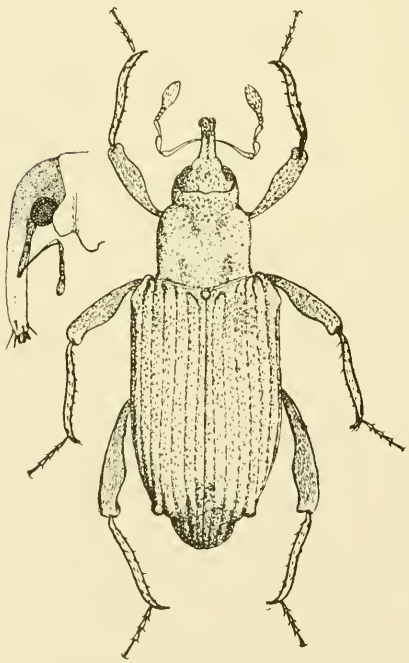

Fig. 5
Bagous longirostrus, New Species
X 12. (Original)

Size: 4 to 4.5 mm. in length.

Type locality: Lake Koshkonong, Fort Atkinson, Wisconsin, July 19, 1923; D. R. Hylan, collector. Type a female deposited in the entomological collection of the United States National Museum, Washington, D. C.; also two paratypes both from Michigan are in the United States National Museum, Acc. 21542. Two paratypes in the writer's collection at Brigham Young University, one from Michigan and one from Buffalo, New York.

Remarks: This species is similar in general facies to *americanus* but may be separated from it by the long beak, uniform reddish color, long fourth tarsal segment with divergent claws, and whitish pubescence. The genital structures are more heavily chitinized than in *americanus*. LeConte made the observation that there was a marked difference in the beak of the two sexes of *americanus*. "That of the male is stout, shining, very finely punctulate, not longer than the prothorax, and about one-half as wide as the head; in the female it is slender, one-third longer and with the antennae inserted about the middle of the length." The female of *americanus* is similar in beak characteristics to the male, as revealed by dissecting several specimens of both sexes. I have studied more than a hundred specimens of *americanus* and find that it is distinctive to *longirostrus*. I had one specimen of this new species when Mr. Buchanan sent me four additional specimens calling my attention to their long beaks.

Bagous americanus Lec.

LeConte and Horn, Rhynch. 1876, p. 185.

Black or brown, with grayish scales; beak of male and female stout, shining, broad at the tip and as long as the prothorax, antennae inserted on distal third in both sexes. Prothorax longer than wide, sides parallel on basal third, rounded on middle third, broadly constricted near the tip, surface finely punctured but covered with ocellate scales. Elytra at base one-third wider than thorax; humeral angles obtuse, surface covered with fine ocellate scales, some specimens with two large white spots behind the middle, intervals flat, striae fine and with shallow punctures; a small tubercle between the declivity and the apex on the fifth interspace. Male and female genitalia shown in Figures 32, 33 and 37. The female structures are distinctive, the coxites not so long and heavily chitinized as in *longirostrus*. Legs reddish, fourth joint of tarsus not so long as the two preceding, claws not so divergent.

Size: 3.5 to 4 mm. in length.

Distribution: Crescent City, Florida; Waveland, Mississippi; Oke-

fenokee, Georgia; Kenilworth, Washington, D. C.; Falls Church, Virginia; Jamesburgh and Budds Lake, New Jersey; Lake George, Spencer Lake, Vicinity of New York; Buffalo, Peckstill, Olcott and Esopus, New York; Mansfield, Chicopee and Westfield, Massachusetts; State College, Pennsylvania; Monroe Co., Illinois; Kascinsko Co. and Vigo Co., Indiana; Detroit and Ottawa Co., Michigan; Sudburg, Ontario; Ithasca Park and Olmsted Co., Minnesota; and West Bend and Elkhom, Wisconsin.

Remarks: *Americanus, longirostrus, blanchardi* and *texanus* form a natural group that are separated by definite characters as set forth in the species key. *Americanus* is much larger and with longer, reddish colored legs with slightly broadened tarsi in contrast to *blanchardi.*

Bagous blanchardi Blatch.

Blatchley and Leng, Rhynch. 1916, p. 235.

"Much smaller and more slender than *americanus.* Vestiture as there, the entire surface very even, smooth and clothed with silvery gray ocellate scales; antennae, except club, tibiae and tarsi pale reddish-brown; femora black, reddish at base. Beak shorter than thorax, slender, cylindrical, almost straight, front with a small shallow fovea. Thorax subcyindrical, as long as wide; disc broadly feebly constricted near apex. Elytra as in *americanus,* intervals all flat, the fifth with a small tubercle on declivity. Femora much more slender; tarsi more than half the length of tibiae, the third joint not broader nor emarginate. Length 2.8 to 3 mm."

Distribution: Dracut, Chicopee and Tygsboro, Massachusetts; Providence, Rhode Island; and Lake Oscawana, New York.

Remarks: A small elongate species with black to dark red femora.

Bagous texanus Tanner, n. sp., Fig. 6

Type female: Elongate, dark red to black, covered with whitish to dark brown small ocellate scales, forming indistinct lateral and a medial vittiae on the prothorax and with interspace spots on the elytra, especially behind the middle. Antennae and legs light red covered with scales; beak curved, dark brown covered throughout with scales, tricarinate with rows of setae which arise in punctures on each side of the median carina; scrobes deep; frontal fovea distinct, area covered with whitish scales. Prothorax a little wider than long, sides slightly rounded, widest near the middle, a narrowed and broadly constricted near the tip; finely punctured and smooth with a median depression at the base, bordered by blackish scaled areas. Elytra nearly one-half wider than the prothorax, humeral angle obtuse, rounded; striae medium with deep punctures; interspaces broad, only slightly elevated and

with decumbent white setae; only one small tubercle on the declivity and the fifth interspace. Whitish blotches or bands on third, fourth and fifth interspaces, back of the middle. Legs short, femora strongly clavate, tibia slightly arcuate, claw heavy set., tarsus short, fourth segment only as long as the two preceding combined: first, second and third segments a little broader.

Size: 3.5 to 3.8 mm. in length.

Type locality: Victoria, Victoria County, Texas. Collected by J. D. Mitchell on *Cyporus virens* Michx. Type and eleven paratypes in the United States National Museum collection; six paratypes in the author's collection at Brigham Young University, five from Victoria, Texas, and one from Lake Harney, Florida.

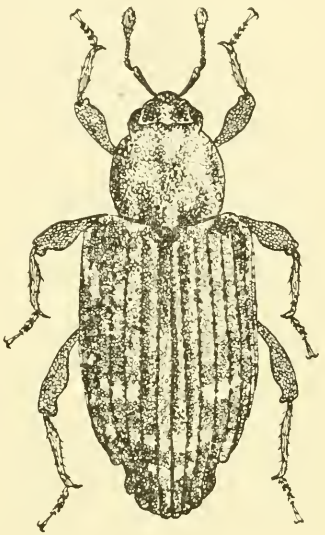

Fig. 6
Bagous texanus, New Species
X 13. (Original)

Remarks: *Texanus* resembles *americanus* from which it differs as follows: thorax wider and more rounding, disc smooth, striae of elytra deeper and with prominent punctures, surface shining, scales smaller and less ocellate; tibia shorter with larger claw. Known only from the type locality and Lake Harney, Florida.

Bagous cavifrons Lec.

LeConte and Horn, Rhynch. 1876, p. 186.

Black, clothed with fuscous black scales, with an oblique row from the humeri to the declivity which ends in two large spots on the third intervals. Beak stout, curved, tricarinate, scaly, finely punctured, as long as prothorax and with well developed frontal fovea. Prothorax about as wide as long, sides parallel to the tip where it is distinctly constricted; surface scarred with deep impressions and coarsely granulate. Elytra about one-half wider than the prothorax; first, third, fifth and seventh interspaces more convex, third produced into small tubercle at the declivity while the fifth has a well formed tubercle on the apical area; striae punctured, interspaces with a row of whitish decumbent setae. Legs blackish except the tarsi which are dark reddish; tibiae shorter; tarsi short, fourth segment not as long as the two preceding combined, claws not so divergent.

Size: 3.7 to 4.1 mm. in length.

Distribution: Dunedin, Crescent City and Archer, Florida; Irvington, New Jersey; Massachusetts; Illinois; Michigan and Louisiana.

Remarks: Markings and thoracic sculpturing similar to *magister*, but smaller and with less spotting.

Bagous magister Lec.

LeConte and Horn, Rhynch. 1876, p. 187.

Blackish-brown, the elytra spotted with fuscous and pale brown scales, with a transverse spot of grayish scales crossing the suture behind the middle, this spot is sometimes interrupted at the suture; antennae and tarsi dark reddish-brown. Beak tricarinate, finely punctured, as long as the prothorax and with a deep elongate fovea between the eyes. Prothorax longer than wide, widest at the base, then slightly tapering to near the tip where it is broadly constricted, surface with irregular deep impressions, punctate, and with deep channel at middle. Elytra about one-half wider than prothorax, humeri rounded, striae deeply punctured, third, fifth and seventh interspaces more convex; tubercle posterior to the declivity prominent; a pale spot, just back of the middle extending from the fifth to the third interspace, in some specimens beyond to the suture; antennae and tarsi dark reddish; legs short, tarsi similar, but tibiae longer than in *cavifrons*. The female genitalia are well developed, coxites largely chitinized with prominent styli, eight sternite mainly membraneous. The male aedeagus is distinctive. Figures 24 and 34.

Size: 4.3 to 5.1 mm. in length.

Distribution: Good Haven, Michigan; Ramsey, Minnesota; Toronto, Ontario; Massachusetts, Penn Yan, New York; Seaside Hts. and Irvington, New Jersey; Indiana; Allgonquin, Illinois, Iowa; and Paradise and Dunedin, Florida.

Remarks: *Magister* is the largest native species of Bagous. It is widely distributed being found on water lilies. The deep impressions on the prothorax, spotting on the elytra and large size make this species easily separated from other species of Bagous.

Bagous carinatus Blatch., Fig. 7

Blatchley, W. S. Notes on the Rhynchophora of Eastern North America with Description of New Species, III. Jour. N. Y. Ento. Soc., Vol. 33, pp. 95-96, 1925.

Oblong-oval and distinctly robust. Black; head, beak, femora, tibiae, under-surface and prothorax, except for two black basal spots, covered with a coating of fine clay-yellow scales; elytra covered with fuscous-black scales and a whitish bar which unites the fifth intervals across the suture, back of the middle and before the declivity. Beak shorter than the prothorax, curved, stout and tricarinate; front foveate

and scales dense. Prothorax wider than long; sides slightly sinuate, swollen in front of middle, rather sharply constricted near the tip, surface uneven, but not with deep impressions, with a fine median carina reaching from the constriction to the base and with two basal black spots. Elytra about one-half wider at base than prothorax; humeri obliquely angulate; interspaces convex, especially the third, fifth and seventh which are also wider; each with a row of pale setae surrounded by fuscous scales; the fifth with a prominent tubercle on declivity tipped with whitish scales, while the third has a small callous within the white cross-bar; there is a slight depression before the middle from the humeri obliquely to the suture; anterior to this depression the interspaces are definitely elevated. Antennae and tarsi dark red; fourth segment about as long as the second and third combined; segments not broadened.

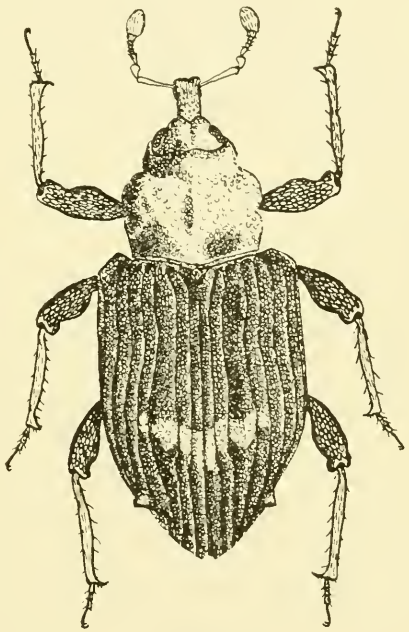

Fig. 7
Bagous carinatus Blatchley
X 13. (Original)

Size: 2.9 to 4.1 mm. in length.

Distribution: Moore, Haven, Paradise Key and Barlow, Florida; Ft. Lee and Caldwell, New Jersey; Penn Yan, New York; Formingham and Wayland, Massachussets; Awenne, Manitoba and Boucheville, Quebec; Detroit, Michigan; Cranmoor, Wisconsin; Illinois; Eddyville, Iowa; Huntington, Ohio; Frontenac, Minnesota; Utah Lake and St. George, Utah; and Vernon, B. C.

Remarks: This species is widely distributed. It has been incorrectly identified in many collections being listed in some as *transversus,* but the color pattern, median thoracic carina and size clearly separates the two species.

Bagous atratus Blatchley

Blatchley and Leng, Rhynch. 1916, p. 233.

Black, clothed with black distinctly ocellate scales, elytra with a grayish-white cross-bar crossing the suture between third intervals at the upper edge of the declivity. Beak short and stout, less in length

than the prothorax, with fine carinae and a distinct frontal fovea. Prothorax, wider than long, constriction at tip well developed, surface granulate and with median channel. Elytra one-third wider than the prothorax; humeri rounded; interspaces convex the third and fifth more so; striae fine with obscure punctures; noticeable decumbent setae on the fifth and seventh interspaces which are surrounded by whitish scales, giving an obscure spotting appearance. Cross-bar of whitish scales distinctive, being .5 mm. in width and covering the area between and including the third intervals. Antennae and tarsi dark red in color; fourth segment greater in length than the second and third combined, third segment not broad and claws on fourth not divergent.

Size: 3.0 to 3.2 mm. in length.

Distribution: Michigan; Palo Alto Co., Iowa (Bufo. 2011); and the type locality, Virgo County, Indiana.

Remarks: *Atratus* resembles in general facies *planatus* from which it is easily separated by tarsal structures and the distinct white cross-bar. Rare in collections; known only from the type in the Purdue collection and the two specimens discussed above, one of which will be deposited in the United States National Museum and one in the writer's collection at Brigham Young University.

Bagous maculatus Blatch.

Blatchley and Leng, Rhynch. 1916, p. 232.

Black, covered with slate-gray coating and scales in an obscure pattern of lateral prothoracic stripes and spots on the elytra, a small round to oblong one, back of the middle. Beak stout, curved and short, not as long as the prothorax; front granulate and scaly; fovea very small. Prothorax about equal in width and length; sides widest beyond the middle to near the tip, then only broadly restricted; surface with two obscure whitish stripes, punctate, but covered with slate-gray coating, slightly channeled at the base. Elytra wider than prothorax, broadly rounded humeri, uniformly colored; interspaces only slightly convex, third and fifth wider; fifth with a small tubercle beyond the declivity; an oblong spot of whitish scales back of the middle. Antennae, funicles, distal parts of the tibiae and tarsi dark red in color.

Size: 3.8 to 4.1 mm. in length.

Distribution: Known only from Dunedin, Florida.

Remarks: Through the kindness of Dr. J. J. Davis in charge of the Blatchley collection at Purdue University I have had the opportunity of studying two of the three specimens of *maculatus* in the Blatchley collection. "The large size, distinctly maculate elytra, and tibiae, red only near the apex," as Blatchley observes, may be used in distinguishing this species.

Bagous nebulosus Lec.

LeConte and Horn, Rhynch. of Amer. 1876, p. 186.

Form robust, black, covered with dirty scales, variegated with darker and paler ones. Beak slender, curved, finely punctulate, free from scales except at the base; as long as the prothorax. Prothorax wider than long, sides straight to near the tip then rather sharply and deeply constricted, surface coarsely granulate and covered by dark and pale scales which make two obscure lateral stripes. Elytra wider by one-third than the prothorax; humeri obtusely angular and prominent; striae deep and punctured; punctulation obscured by scales and coating; interspaces convex and about equal except the third one which is wider; fifth bears a small callus; all interspaces with a row of decumbent pale colored setae; a pale colored band extends irregularly from the humeri to back of the middle. Antennae and legs dark red. Tarsi are short, especially the first three segments, fourth segment slender and almost as long as the first three combined.

Size: 3 to 3.5 mm. in length.

Distribution: Port Huron and Gd. Ledge, Michigan, June; collected by Hubbard and Schwarz; Brookline and Dover, Massachusetts; Chinchilla, Pennsylvania; New York; Washington, D. C.; Iowa; and Laramie, Wyoming.

Remarks: I have before me two specimens from the United States National Museum, one of which is from the type locality, Port Huron, Michigan, and was collected by Hubbard and Schwarz. The other one collected by these two famous collectors is from Gd. Ledge, Michigan. The specimen from Port Huron may well be considered as a valuable topotype if not a paratype although it was probably not in LeConte's possession when the species was named. I have made the description above from this specimen, which is being properly labeled and returned to the entomological collection of the United States National Museum. The variegated scale pattern and markings is very distinctive.

Bagous californicus Lec.

LeConte and Horn, Rhynch of Amer. 1876, p. 187.

"Rather robust, black, clothed with dark-gray scales of uniform color. Beak stout, curved, shorter than the prothorax, scaly; frontal fovea not deep. Prothorax wider than long, coarsely granulated and rugose; sides straight, diverging slightly from the base for two-thirds the length, then rounded and narrowed to the tip, where it is strongly constricted; with a broad dorsal channel near the base. Elytra nearly one-half wider than the prothorax, humeri oblique, slightly rounded; sides parallel, then obliquely narrowed and narrowly rounded at the tip, disc flattened from the suture to the third stria, and from the

base for three-fifths the length, striae fine, interspaces slightly convex; posterior callus prominent; there is a feeble tubercle on the third interspace at about two-thirds the length. Antennae and legs reddish brown; tarsi long. Length 2.8 mm; .11 inch.

One specimen, San Diego, California; G. R. Crotch.

Differs from *B. restrictus* by the tubercle on the third interspace behind the middle, and by the absence of the white spot which occupies a similar position in that species."

Remarks: I have before me several specimens of Bagous from Los Angeles and Redondo, California, which are clearly *restrictus* due to the presence of the white spot back of the middle and the tubercle on the third interspace. I am unable to separate the Texas and California specimens. Mr. Werner compared my California specimens with LeConte's type of *californicus* and considered one of them as similar to the type, but commented that "type MCZ 5297 has been rubbed slightly. The white spot is present, although indistinct because of this, a slip, on LeConte's part." If the San Diego specimen (type of *californicus*) has a distinct third interspace tubercle along with other morphological characters, mentioned in the description, it undoubtedly is a distinct species. At present I am inclined to believe that *restrictus* my be a synonym of *californicus*, but the types of the two species must be carefully studied in the light of our present knowledge of the species of Bagous. Until this is done these species are treated as distinct.

Bagous chandleri Tanner, n. sp., Fig. 8

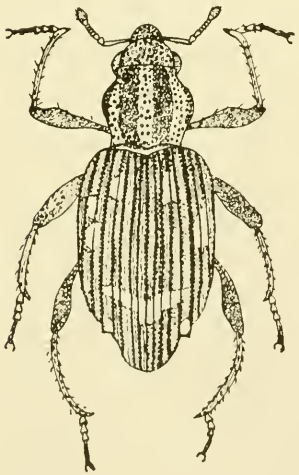

Fig. 8
Bagous chandleri, New Species
X 14. (Original)

Rather elongate, black, covered with cinereous, variegated scales over the body, prothorax, head beneath and legs; a whitish band behind the middle connecting across the suture, the third interspaces; antennae, femora, tibiae and tarsi red, except the distal ends of the femora which are black. Beak black, stout, slightly curved well toward tip with white scales, not as long as the prothorax, front broadly impressed and densely covered with white scales and coating. Prothorax about one and one-third as wide as long; sides diverging from the base to beyond the middle where it is widest, a broad constriction at the tip; surface granulate and finely punctate; with a broad basal and apical median depression; covering uniform whitish ocellate scales. Elytra one-third

wider than prothorax humeri oblique, not prominent, sides straight for four-fifths the length then smoothly rounded at the apex; interspaces slightly convex, the third and fifth a little wider than the others; the fifth with a small conical tubercle on the declivity; a distinct whitish cross-bar between the third interspaces; interspaces each with a row of pale setae; tarsi long, the fourth segment as long as the two preceding combined; claws divergent and long; third segment not emarginate or broad.

Size: 2.5 to 2.9 mm. in length.

Type locality: Type, Utah Lake shore, Utah County, Utah, (Harry P. Chandler, June 6, 1941; paratypes, Utah Lake shore, Wickham and Chandler, collectors; mouth Bear River, Boxelder County, Utah, A. Wetmore, collector, July 12, 1915; and one specimen collected in Washington, D. C., on *Eleocharis palustres* which was collected at Havee, Montana. Type and partypes in the writer's collection at Brigham Young University. Nine paratypes in the United States National Museum. One paratype in the Entomological Collection of the Museum of Comparative Zoology at Harvard College, Cambridge, Massachusetts.

Remarks: In general appearance this species seems to be related to the *californicus-restrictus* complex. The white variegated scales and coating along with the size, wide prothorax, short, stout beak and long tarsi make this a distinctive species. Named in honor of the collector and a former student of entomology,now in the Naval forces of our country.

Bagous tingi Tanner, n. sp., Fig. 9

Oblong-oval, robust, rubescent to black covered with grayish white scales and coating. Prothorax and elytra scales noticeably ocellate, the red color of the integument showing through the covering of scales. Beak not as long as the prothorax, curved, tricarinate, the median carina well developed and extending from the origin of the scrobes to the broad well developed fovea of the front which is black granulate and with white scales; sides and tip reddish and punctulate. Prothorax wider than long, widest beyond the middle, strongly constricted at the tip; surface granulate, with a median channel at base and tip interrupted at the middle; elytra only one-fourth wider than the prothorax; humeri broad and oblique; interspaces practically flat, except the third and fifth which are slightly convex and wider. The fifth with a small tubercle on the declivity; striae shallow and finely punctured. Antennae and legs red, distal portion of femora black; tarsi, fourth segment about as long as the three preceding segments combined, claws long and divergent.

Size: 2.8 to 3.1 mm. in length.

Type locality: Lake Pilarcitos, San Mateo County, California; collectors, P. C. Ting and M. Cazier, August 27, 1939. Type and one paratype in writer's collection at Brigham Young University; one paratype in Mr. P. C. Ting's collection, San Francisco, California, and one paratype in the entomological collection, United States National Museum, Washington, D. C. The four specimens from the type locality.

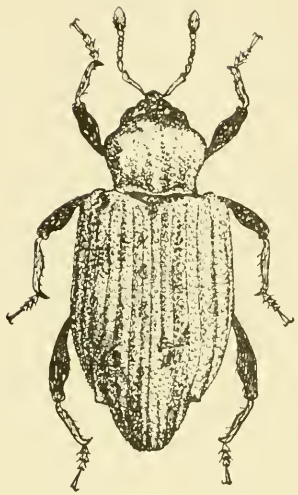

Fig. 9
Bagous tingi, New Species
X 15. (Original)

Remarks: *Tingi* has a rubescent color, a beak that is tricarinate, no white spot before the declivity, long tarsi and size about 3 mm. It is closely related to *chandleri*.

Bagous restrictus Lec.

LeConte and Horn, Rhynch. of Amer. 1876, p. 187.

Black, covered with dirt-colored scales, with some brown to blackish scales intermixed, white spots on the second and third interspaces, also the tubercle on the declivity. Beak carinate, not as long as the prothorax; distal reddish, front clothed with dirt-colored scales, which obscure the fovea. Prothorax wider than long, widest just before the tip which is broadly constricted, surface finely granulate and with slight basal channel. Elytra wider than prothorax, humeri oblique, not prominent; interspaces slightly convex, third one widest, fifth with a small conical tubercle on the declivity; the white spot before the declivity and the white of the tubercle noticeable. Legs, antenna and distal portion of the beak reddish, tarsi long, fourth segment not so long as in *chandleri* and *tingi*, but about as long as the second and third segments combined.

Size: 2.4 to 2.7 mm. in length.

Distribution: Brownsville, Texas; Lake Okoboji, Iowa City and Eddyville, Iowa; Indiana; Illinois; Ithaca, New York; Boucherville, Quebec, Canada; Maryland; California and Oregon.

Remarks: The above is the distribution of the specimens considered as *restrictus*. The California specimens are identical with those from Texas which according to LeConte's description are *restrictus*. Collecting, in the future, around San Diego may result in obtaining specimens of *californicus*.

Bagous puritanus Blatch.

Blatchley and Leng, Rhynch. 1916, p. 233.

"Elongate, slender, subcylindrical. Black, densely clothed with dark gray scales; a stripe each side of thorax, a spot on humeri and a narrow cross-bar between the third intervals of elytra at declivity of whitish ones; antennae, except club, tip of beak, tibiae and tarsi pale reddish-brown. Beak much shorter than thorax, slender, curved; front not foveate. Thorax as wide as long, sides feebly curved constricted near apex; disc densely and finely granulate. Elytra one-third wider at base than thorax, sides straight to the declivity, then strongly converging to apex: third interval slightly more convex than the others, tubercle of the fifth very faint. Length 2.5 mm. (W.S.B.)"

Distribution: Dracut and Nantucket Island, Massachusetts.

Remarks: The above is a short, good description of *puritanus*. The gray scales and coating gives the appearance of a powder on the body. To the above description should be added the following: Legs not long, slender; tarsi not long, fourth segment about as long as the three preceding combined; distal end of the fourth segment black. Through the kindness of Dr. Banks and Mr. Werner of Harvard College I have had an opportunity of studying specimens of this species.

Bagous pusillus Lec.

LeConte and Horn, Rhynch. of Amer. 1876, p. 187.

"Less robust, black, clothed with dirt-colored scales, elytra with a broad toothed transverse band behind the middle. Beak stout, curved, as long as the prothorax, scaly, frontal fovea faint. Prothorax about as wide as long, sides straight, suddenly rounded, narrowed and strongly constricted near the tip; coarsely granulated. Elytra nearly one-half wider than the prothorax, humeir prominent, oblique and rounded, sides nearly parallel, then oblique, tips rather broadly rounded, posterior callus small, very prominent; striae fine, interspaces nearly flat. Antennae and legs brown, tarsi long. Length 1.8 mm.; .07 inch."

Distribution: Capron, Florida; Illinois; and Mt. Co., Massachusetts.

Remarks: This is one of the smallest American species of Bagous, ranging from 1.8 to 2.2 mm. in length. The brownish black band; prominent tubercle and small size gives this species considerable distinctiveness.

Bagous bituberosus Lec.

LeConte and Horn, Rhynch. of Amer. 1876, p. 188.

"Black, covered with dirt-colored scales. Beak stout, shorter than

the prothorax, which is of the same form as in the preceding, feebly channeled and more finely granulate. Elytra wider than the prothorax, humeri less oblique, obtusely angulated, prominent; striae deep, interspaces convex, fifth more elevated behind, and terminating in a large tuberosity; the third is a little wider and more convex than the adjoining ones. Antennae, tibiae and tarsi dark testaceous; third joint not dialated, fourth as long as the two preceding united. Length 3 mm.; .12 inch."

Distribution: Lawrence, Kansas; Eddyville, Iowa; Indiana; Boucherville, Quebec and Montreal, Canada.

Remarks: This is one of the most misidentified and confused species of Bagous. LeConte referred a specimen from Capron, Florida to this species which Mr. Werner reports is not the same as the Kansas specimen, a cotype. This being the case the Kansas specimen is considered as the type and the Florida specimen which seems to be distinct is probably an undescribed species according to Mr. Werner. All the specimens I have studied have a prothorax which is as wide, if not slightly wider than long, a white spot before the declivity on some specimens, also a slight mixture of brownish and gray scales, and with the interspaces more convex than in *floridanus*. The third interspace has a slight callus in some specimens.

Bagous floridanus Tanner, n. sp.

Oblong-oval. Black, clothed with uniform dirt-colored scales, except for two white spots before the declivity on the second and third interspaces and obscure pale lateral stripes on the prothorax. Beak as long as the prothorax, slender, distinctly tricarinate, fovea small, front and beak to near the tip covered with scales; scrobes deep to the eyes. Prothorax as wide as long, finely granulate sides slightly sinuate, widest just before the tip which is constricted, the channel being broadly rounding; pale lateral stripes. Elytra about one-half wider than the prothorax, humeri obtuse; sides slightly sinuate before the middle; surface with ocellate scales; intervals only slightly convex, third with a very small callus at the white spot, fifth with a small conical tubercle on the declivity. Antennae, except the club, tibiae and tarsi dark red; fourth segment about as long as the three preceding ones. Third segment not broad; a band of white scales on the outer surface of the swollen portion of the femora.

Size: 3 to 3.2 mm. in length.

Type locality: Enterprise, Florida. Type and eight paratypes from Enterprise, Florida in the entomological collection, Museum of Comparative Zoology, Harvard College, Cambridge, Massachusetts. Four paratypes in the writer's collection at Brigham Young Univer-

sity, three from Enterprise, Florida, and one from Ithaca, New York. Two paratypes in the United States Natural Museum, both from Enterprise, Florida. Two paratypes in the Purdue Blatchley collection, Purdue University, one from Lake Okeechobee, Florida, and one from Enterprise, Florida. Two paratypes in the California Academy of Science, San Francisco, California, both from Enterprise, Florida, and one paratype from Enterprise, Florida in the Cornell University Entomology collection, Ithaca, New York.

Remarks: The white spots on the elytra and femora, conical tubercle, tricarinate beak and regular slightly convex interspaces distinguish *floridanus* from *bituberosus*. Mr. Werner reports that the Florida specimen referred to *bituberosus* by LeConte is not cospecific with the Kansas specimen. *Floridanus* described from Enterprise, may be the same as the Capron, Florida specimen. In any event, it is a distinctive species being remarkably uniform in color, color markings and body shape in the 21 specimens of the type series.

Bagous pauxillus Blatch.

Blatchley and Leng, Rhynch. 1916, p. 238.

"Oblong-oval. Piceous-black; above clothed with clay-yellow and dark brown scales, the paler ones covering the head, most of the thorax and forming a broad, uneven stripe along each side of the elytra, these merging across the declivity; four small spots across base of thorax and a large triangular discal one on elytra dark brown; under surface of body and apical halves of femora sooty brown; antennae and remainder of legs reddish. Beak one-half as long as thorax, stout, naked and finely punctate near apex; front with an elongate fovea. Thorax subcylindrical, as long as wide, sides straight, feebly constricted near apex, disc finely and densely granulate-punctate. Elytra broadly oval, one-third broader at base than thorax, humeri rounded, sides straight to declivity; intervals feebly convex, minutely setose, the fifth with a prominent tubercle on declivity. Length 2 mm. (W.S.B.)"

Distribution and Remarks: Known only from the type locality, Guilford, Connecticut and Massachusetts. I have never seen a specimen of *pauxillus* and since I have no reason to question its distinctiveness as portrayed by Blatchley it is undoubtedly a good species.

Bagous transversus Lec.

LeConte and Horn, Rhynch. of Amer. 1876, p. 188.

Robust, oblong and less convex. Black covered with dirt-colored scales; beak as long as the prothorax, curved, naked, carinate just

shortly below a distinct fovea. Prothorax wider than long by about one-third, widest near the tip where it is distinctly constricted; surface finely granulate, sides sinuate; no trace of median channel. Elytra uneven, marked with faint impressions, interspaces convex, all about the same in width, striae fairly deeply punctured; tubercle on declivity well developed. Legs and antennae, except the club, dark red to black; tarsi short, especially the fourth segment.

Size: 2.3 to 2.7 mm. in length.

Distribution: Detroit, Michigan; Irvington, New Jersey; New Haven, Connecticut; and Brookline, Massachusetts.

Remarks: *Transversus* has been greatly confused and misidentified in the collections that I have been permitted to study. Blatchley's *carinatus* has been most frequently considered as *transversus*. The color markings and distinctly carinate prothorax easily separates them. LeConte's description fails to mention any white scales as spots or bars on the elytra. Mr. Werner has compared a specimen of what I consider *carinatus* with *transversus* and reports that they are very similar, even may be considered as identical. *Transversus* was described from a single specimen taken at Detroit, Michigan. It should now be studied in connection with other specimens of *transversus* as well as other species of Bagous, in order that the range of variations may be noted. With the aid of several specimens compared with the type by Mr. Werner, and after a careful study of the original description the specimens now considered as *transversus* are distinctive. LeConte emphasizes the anterior prothorax in *transversus*. Specimens considered as this species do not seem to have the prothorax more strongly constricted and tubulate than other species of this genus.

Bagous ochraceus Blatch.

Blatchley and Leng, Rhynch. 1916, p. 237.

"Short, oval, robust. Piceous, everywhere densely clothed with a crust of dirty yellow scales; antennae and legs dark red. Beak rather slender, curved, as long as thorax, densely scaly, finely and densely punctate. Thorax one-third wider than long, sides broadly rounded, strongly constricted near apex. Elytra oval, one-fourth wider at base than thorax, humeri rounded, sides evenly converging to declivity, then more strongly so to apex; striae deep, intervals convex, each with a row of fine whitish recurved setae; the tubercle on declivity scarcely evident. Tibiae and tarsi short, stout. Length 2.3 to 2.5 mm. (W.S.B.)"

Distribution: Dubois County, Indiana, the type locality; Garland, Colo.; Laramie, Wyoming; and Utah Lake, Utah.

Remarks: In 1930 I obtained from Mr. Blatchley, by purchase,

several hundred species of weevils. Included in this collection was a pinned labeled cotype of this species. It and specimens from the above localities agree well with the description. The tubercle on the declivity is "scarcely evident" in all specimens; also rather thick crusting which obscures the sculpturing of the prothorax and elytra.

THE GENUS PNIGODES

The genus Pnigodes was described by LeConte in 1876.[17] This genus is similar to Bagous both as to habitat and general facies. Pnigodes possesses the following distinctive characteristics: the second joint of the funicle is as long as the next three combined; the legs are stouter and longer; the fourth joint of the tarsi as long as the other three combined; prothorax wider than long and suddenly and strongly constricted and tubulate in front; and elytra wider than prothorax with well developed interspaces.

KEY TO SPECIES OF PNIGODES

1. Tarsi broader and emarginate. Prothorax with black vitta bordering the white median channel; lateral portions of elytra whitish, median portion chestnut brown to black; size 3.5 mm.....*buchanani* n. sp.

   Tarsi narrow and not emarginate; prothorax without black vitta; lateral portions of elytra not whitish.....2

2. Prothorax and elytra coarsely granulate; a white band behind the middle, which connects the third interspaces; one small tubercle on declivity of each elytron; size 2.5 to 2.9 mm.....*setosus* Lec.

   Prothorax and elytra without granulation; prothorax uniformly whitish to yellowish except for two basal dark spots bordering the median channel; four tubercles on the declivity of each elytron; size 4.15 mm...*tuberosus* n. sp.

Pnigodes buchanani Tanner, n. sp., Fig. 10

Type: Female, elongate, slender. Chestnut brown to black, covered beneath, lateral portion of elytra, sides and on median, channel of prothorax with whitish scales. Legs and antennae dark red. Beak long, curved not carinate, slender and black; front with a distinct fovea; finely granulate, with light yellow and brown scales intermixed. Prothorax wider than long, rather flat on top and angulate from base to widest part anterior to middle, then strongly constricted and moderately tubulate; black vitta from base to apex on each side of shallow whitish channel, surface moderately granulate. Elytra slightly wider than prothorax, humeri prominent, angle obtuse, inter-

(17) Op. cit. p. 188.

spaces separated by well developed striae; third and fifth only a little more elevated, fifth bearing a tubercle at the declivity; color pattern distinctive, the central area including the third interspaces from the base to apex chestnut brown to black; while the lateral portions including the tubercle are whitish. The interspaces each have a row of whitish setae. The tarsi are moderately long; the fourth segment as long or longer than the other three combined; the third segment is broad and emarginate. The first segment of the funicle is large, the second one is as long as the next three combined.

Size: 3.5 to 3.6 mm. in length.

Type locality: Opelousas, Louisiana, collected by R. A. Cushman, on *Ptilimnium capillaccum* (Michx.) on May 7, 1908. Type and five partypes in the entomological collection of the United States National Museum. Four paratypes in the author's collection, Brigham Young University.

Remarks: *Buchanani* differs from *setosus* in that it is larger, with less tubulation on the constricted portion of the prothorax, less granulate on thorax and elytra and with a very different color pattern. They

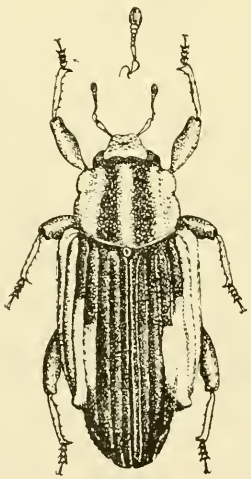

Fig. 10
Pnigodes buchanani, New Species
X 12. (Original)

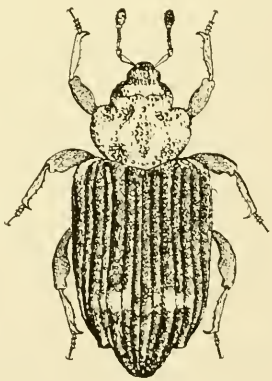

Fig. 11
Pnigodes setosus LeConte
X 14. (Original)

are similar since the second joint of the funicle is long, the legs are stout and long, the fourth joint of the tarsi is as long as the other three combined and the claws are long and divergent. The third tarsal joint is broader and emarginate in *buchanani*. Both species have a median channel on the prothorax and a depression from the base of the elytra to the apex along the suture between the third interspaces.

The third interspaces are slightly elevated. All the interspaces have a row of decumbent white setae. The tubercle on the fifth interspace is larger in *buchanani* than it is in *setosus*. The female genitalia are similar in that the valvifers are not present; the coxites bear small terminal styli and the eighth sternite is largely membraneous with two chitinized areas forming a V. The spermathecae of *setosus* is less crenulate than *buchanani*.

Pnigodes setosus Lec., Fig. 11

LeConte and Horn, Rhynch. of Amer. 1876, p. 189.

"Black, covered with a dirt-colored crust; prothorax deeply and broadly channeled; elytra finely striae with the alternate interspaces elevated, and bearing each a row of long bristles; a transverse common pale spot is seen behind the middle, extending from the suture to the third stria. The antennae and legs are brown. Length 2.4 to 2.8 mm.; .09 to .12 inch."

Distribution: Calvert, Paris and Brownsville, Texas; Louisiana; Riley Co., Kansas; Gresham, Nebraska; Iowa; Lake Preston, South Dakota; Santa Ana, California; Peach Springs, Arizona; and Helena, Montana.

Remarks: *Setosus* is found to be fairly widely distributed. Specimens have been bred from the roots of *Lepidium* sp. at Calvert, Texas. In the original drawings of these species, now assigned to this genus, the generic and specific characters are clearly shown, which should be of aid in separating the species.

Pnigodes tuberosus Tanner, n. sp., Fig. 12

Type female: Elongate, oblong. Black, densely clothed with brownish yellow, very small ocellate scales; anterior thorax and posterior portion elytra lighter in color; beak and femora black; antennae, tibiae and tarsi dark red in color. Beak shorter than the prothorax, slightly curved with sparse black scales on upper portion, anterior glabrous; front broadly impressed, covered with light yellow scales. Prothorax wider than long, narrowed behind, with a widening to the lateral tubercle before the middle then greatly constricted, but not tubulate; surface with shallow impressions, dorsal channel complete, with two dark basal spots near the channel. Elytra more than one-half wider than the prothorax, humeri oblique and tuberculate; the tubercle on the origin of the seventh and eighth interspaces; the fifth interspaces are more convex, each with an anterior and two posterior tubercles, the posterior tubercle on the declivity is .5 mm. in length; the third interspaces more elevated than the contiguous ones, each with a tubercle on the declivity and the apex, the apical ones are about

one-half the size of the tubercles on the declivity of the fifth interspaces; disc flattened and sloping to the suture, making a wide depression from the base to the apex which includes the first and second interspaces; the basal half is brownish while the posterior half is yellowish. Second joint of the funicle is as long as the next three combined. Tarsi long, third joint not dilated, fourth as long as the three preceding united, legs long, hind tibiae heavy and strongly arcuate.

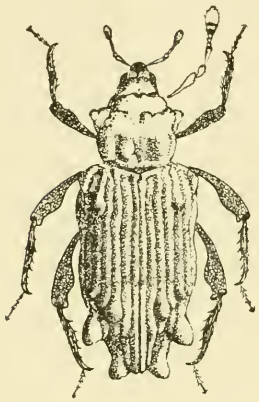

Fig. 12
Pnigodes tuberosus
New Species
X 9. (Original)

Size: 4.1 mm. in length.

Type locality: Described from a single specimen collected in Iowa. Holotype in the writer's collection at Brigham Young University.

Remarks: This is a most distinctive species, which may be easily separated from other described species by the lateral tubercles of the prothorax and the several large tubercles of the elytra.

EXPLANATION OF PLATE I

Female Genitalia

Fig. 13. Ventral view of *Endalus limatulus* (Gyll.)
Fig. 14. Spermathecae of *Endalus limatulus* (Gyll.)
Fig. 15. Ventral view of *Onychylis nigrirostris* (Boh.)
Fig. 16. Spermathecae of *Onychylis nigrirostris* (Boh.)
Fig. 17. Ventral view of *Anchodemus hubbardi* Lec.
Fig. 18. Ventral view of *Lissorhoptrus simplex* Say.
Fig. 19. Spermathecae of *Lissorhoptrus simplex* Say.
Fig. 20. Ventral view of *Bagous mamillatus* Say.
Fig. 21. Ventral view of *Bagous carinatus* Blatch.
Fig. 22. Spermathecae of *Bagous carinatus* Blatch.
Fig. 23. Ventral view of *Bagous tingi*, new species
Fig. 24. Spermathecae of *Bagous tingi*, new species
Fig. 25. Ventral view of *Bagous texanus*, new species
Fig. 26. Ventral view of *Bagous magister* Lec.
Fig. 27. Ventral view of *Bagous ochraceus* Blatch.
Fig. 28. Ventral view of *Pnigodes setosus* Lec.
Fig. 29. Spermathecae of *Pnigodes setosus* Lec.
Fig. 30. Spermathecae of *Pnigodes buchanani*, new species
Fig. 31. Ventral view of *Pnigodes buchanani*, new species
Fig. 32. Ventral view of *Bagous americanus* Lec.
Fig. 33. Spermathecae of *Bagous americanus* Lec.

Male Genitalia

Fig. 34. Aedeagus of *Anchodemus hubbardi* Lec.
Fig. 35. Aedeagus of *Anchodemus angustus* Lec.
Fig. 36. Aedeagus of *Bagous magister* Lec.
Fig. 37. Aedeagus of *Bagous americanus* Lec.
Fig. 38. Aedeagus of *Bagous carinatus* Blatch.
Fig. 39. Aedeagus of *Bagous chandleri*, new species

ABBREVIATIONS

sty ..... stylus
c ..... coxite
vf ..... valvifer
7ths ..... seventh sternite
8ths ..... eighth sternite
9ths ..... ninth sternite

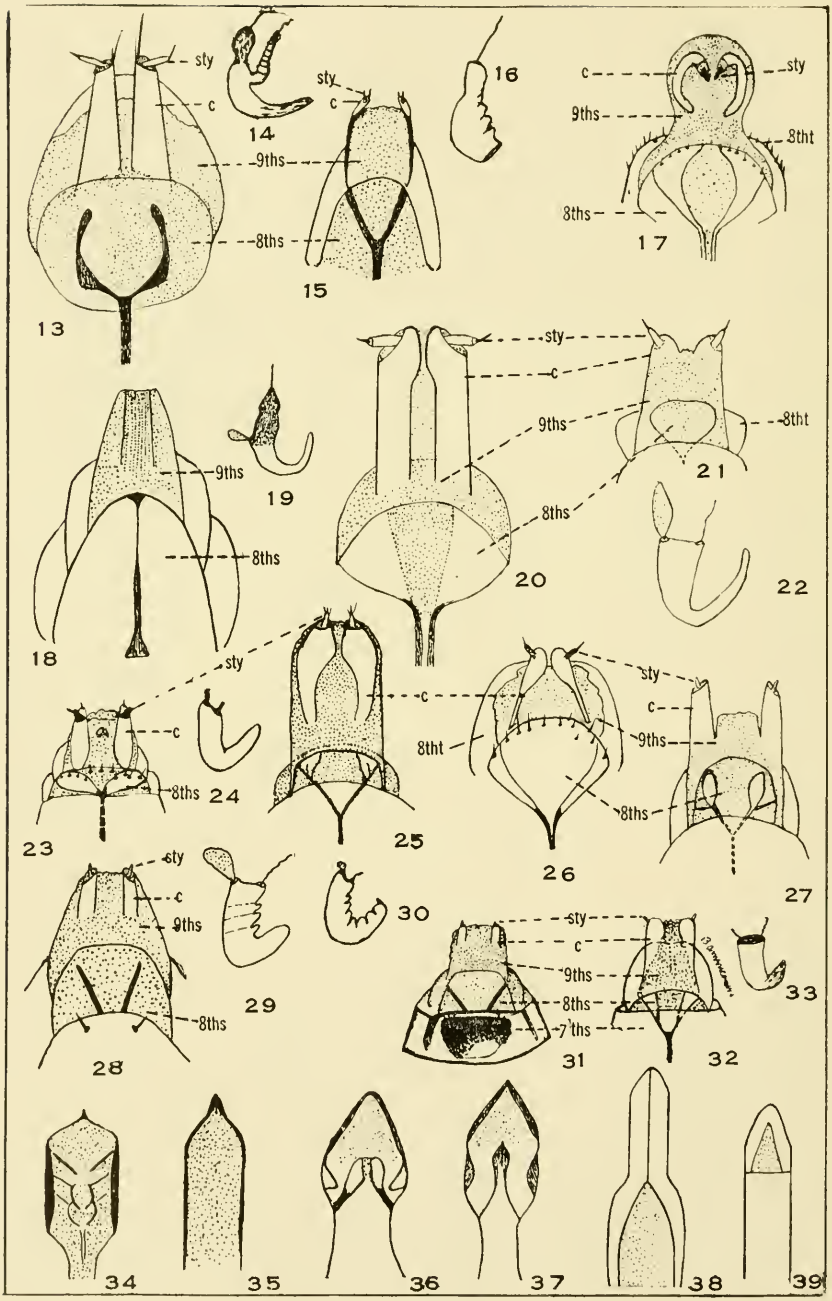

PLATE I

Male and Female Genital Structures of Species of Weevils belonging to the Subtribe Hydronomi

FOUR NEW SPECIES OF COLLEMBOLA

ROY W. CHAMBERLAIN
Department of Zoology and Entomology, Montana State College

In this paper is included, besides descriptions of four new species of Collembola from Montana and Oregon, a key to the Genus *Onychiurus* in North America north of Mexico. The author claims no originality for this key, other than for the newly described species inserted, since it is a compilation from previous keys by Dr. J. W. Folsom and Dr. H. B. Mills.

Two of the new species, *Achorutes thomomys* and *Isotoma spatulata*, are of special interest since they were inhabitants of micro-cavern environment, the former species in gopher burrows in Montana and the latter in the nests of termites in Oregon.

Probably of all the larger genera of Collembola, that of Onychiurus has been worked on the least and is the most incomplete in the literature. While it is believed that the key to the North American species of *Onychiurus* in this paper is complete as far as references in literature are concerned, without a doubt it represents only a very small number of the species of this genus, compared with those which are waiting to be found and described. Leaf mold samples from nearly every new locality and habitat are apt to reward the collector with species hitherto unknown, but comparatively little work has been done on this group because their taxonomic characters are minute and their study represents a painstaking and eyestraining task.

Achorutes thomomys Chamberlain, n. sp.

Color white, eyes absent. Postantennal organ generally with five peripheral tubercules, though occasionally with four or six (Fig. 14). Antennae shorter than the head. Proportion of antennae to head diagonal is as 3 to 4. Olfactory hairs on the 4th antennal segment four in number, three outer and one inner; large subapical tuberculate papilla present; one large apical cup-shaped socket bearing a heavy curved seta, and an adjacent smaller, socketed tubercle bearing a straight, shorter, heavy seta (Fig. 21). Ratio of antennal segments 1 to 4, 9:12:17:18 or 10:12:16:18.

Sense organ of 3rd antennal segment (Fig. 17) with two short oblong-ovate sense processes, three plain guard setae, one serrate guard seta, and two slender fusiform rods about three times as long as the sense processes.

Unguis (Fig. 19) slightly curving, finely tuberculate, with one inner tooth situated one-fourth from the tip. Unguiculus half or slightly more than half as long as unguis (inside measurement), the basal half tuberculate, distal half narrow, acuminate. Praetarsal seta long, nearly as long as unguiculus.

Two tenent hairs, weakly knobbed, the shorter slightly longer than the unguis

and extending to about the mid-point of the unguis; the longer 1 1/3 as long as the unguis and extending approximately to the inner tooth of the unguis.

Dens broad, finely tuberculate and granular, with sparse, heavy dorsal setae, one sub-apical and extending to the tip of the mucro (Fig. 15). Mucro to dens as 1:4; dens to manubrium as 5:8. Furcula extending to about the middle of the third abdominal segment (Fig. 18). Mucro feebly curved and three times as long as its basal width. Bluntly pointed in strict lateral view (Fig. 16); in 3/4 view with a sub-apical tooth-like prominence (Fig. 15), and lateral lamella giving a canoe-shaped appearance. Anal spines (Fig. 20) two, 2/5 as long as hind unguis. Anal papillae prominent, about 2/3 as long as anal horns. Clothing consisting of short, sparse, mostly serrate setae (Fig. 22), more numerous posteriorly. Setae on head irregular; irregular on meso- and meta-thorax, with occasional erect smooth setae slightly longer than the normal body setae. Abd. I, II, III roughly with two rows of setae each; setae more irregularly arranged on Abd. IV, V, and VI. No hairs on tenaculum. Three teeth on each ramus. Total length, .8 to 1.2 mm., not including antennae.

Due to the above combination of characters, this species is radically different from any hitherto described. Probably it falls into the sub-genus *Mesachorutes* Absolon, 1900, due to the reduction in eyes, the type of postantennal organ, and presence of tenent hairs. It might be placed with nearly equal justification in Bonet's subgenus, *Typhlogastrura*, 1930, due to the lack of eyes and pigmentation. The anal horn of this new species is much too small to fit his keys and description, but this is hardly of generic significance. The postantennal organs would fit the species into either the sub-genus *Typhlogastrura* or *Mesachorutes*, since they are of similar type in these two subgenera.

Achorutes thomomys n. sp. differs from Bonet's genotype, *Achorutes (Typhlogastrura) mendizabali*, 1930, which it resembles somewhat, in many respects, especially important among these being the shorter anal horns, the different shape of the claws, furcula, and 3rd antennal segment organ, number of olfactory hairs on antenna 4, and body covering, and in number of lobes of the postantennal organ, *A. mendizabali* having seven while *A. thomomys* has four to six.

This species was collected in great numbers by C. A. Tryon Jr. from a nest of the pocket gopher, *Thomomys talpoides* (Richardson), in the Bridger Mountains near Bozeman, Montana, in August, 1941. The cotypes are in the collection of Dr. H. B. Mills and the author.

Key to the Genus *Onychiurus* in North America North of Mexico

1. Anal spines absent. Tubercles of postantennal organ compound or simple...2
   Anal spines present.....4
2. Tubercles of postantennal organ simple, consisting of 11 to 15.....

.....*ambulans-inermis* forma *oregonensis* Denis, 1929
Tubercles of postantennal organ compound.....3

3. Body stout. Antennal organ with four papillae and two ovate-erect sense clubs.....*fimitarius* L., Lubb., 1767, 1868
Body slender. Antennal organ with five papillae and two subreniform oblique sense clubs.....*pseudofimitarius* Fols., 1917

4. Tubercles of postantennal organ simple.....5
Tubercles of postantennal organ compound.....15

5. Postantennal organ elongate-eliptical with about 18-20 closely set tubercles 6
Postantennal organ with about 8-14 separated tubercles.....12

6. Pseudocelli of antennal bases 3+3.....7
Pseudocelli of antennal bases 2+2 or 4+4.....11

7. Unguiculus about half the unguis. Anal papillae greatly reduced, flat.....*parvicornis* Mills, 1934
Unguiculus more than half the unguis. Anal papillae not greatly reduced..8

8. Furcula represented by two large tubercles. Postantennal organ of forty to fifty irregularly placed tubercles.....*obesus* Mills, 1934
Furcula represented by integumentary fold or not at all.....9

9. Furcula represented by integumentary fold. Tubercles of postantennal organ at right angles to long axis of the organ. Two sense clubs on third antennal organ tuberculate.....10
Furcula not represented by integumentary fold. The two sense clubs on third antennal segment organ granular.....*encarpatus* Denis, 1931

10. Tubercles of postantennal organ not crowded together. Pseudocelli of antennal base arranged in a triangle; those of fifth abdominal segment in a straight line on each side. Unguiculus as long as the unguis.....*armatus* (Tullb.), 1869
Tubercles of postantennal organ crowded together. Pseudocelli of antennal base almost in a straight line; those of fifth abdominal segment in a triangle on each side. Unguiculus much shorter than the unguis.....*pseudarmatus* Fols., 1917

11. Pseudocelli of antennal bases 2 + 2. Postantennal organ with about twenty tubercles.....*litoreus* Fols., 1917
Pseudocelli of antennal bases 4 + 4. Postantennal organ with about thirty-three to thirty-seven tubercles.....*octopunctatus* Tullb., 1876

12. Pseudocelli of antennal bases 2 + 2, rarely 3 + 3....*subtenuis* Fols., 1917
Pseudocelli of antennal bases 1 + 1.....13

13. Anal spines contigious. Sense clubs of antennal organ subovate, oblique .....*similis* Fols., 1917
Anal spines separated.....14

14. Tubercles of postantennal organ 9 in number, with lateral indentations tapering toward the point of attachment at base, giving irregular shape to tubercles; postantennal organ partially or entirely hidden in a fold; pigment absent; dorsal pseudocelli 0, 1+1, 2+2, 1+1, 1+1, 1+1, 1+1, 2+2, 0; unguis stout, strongly curving, untoothed.....*irregularis* n. sp.
Tubercles of postantennal organ 8 to 11 in number, smoothly oval, elliptical or ovate in shape, with no lateral indentations tapering toward base;

postantennal organ not hidden; yellow body pigment usually present; dorsal pseudocelli of body segments 0, 1+1, 1+1, 1+1, 1+1, 1+1, 1+1, 2+2, 0; unguis stout, feebly curving, untoothed.....*cocklei* Fols., 1908

15. Tubercles of postantennal organ distinctly branched.....16
Tubercles of postantennal organ with hundreds of closely set papillae....17

16. Third antennal segment organ with 5 papillae, 2 granular, nearly round sense clubs, 2 sense rods, and 5 guard setae. Pseudocelli on antennal base 3 + 3.....*oreadis* Mills, 1935
Third antennal segment organ with 4 papillae, 2 capitate, coarsely tuberculate sense clubs, 2 sense rods, and 3 guard setae. Pseudocelli on antennal base 2 + 2.....*ramosus* Fols., 1917

17. Anal papillae large; pseudocelli of antennal base 2 + 2, body pseudocelli as follows: 0, 1+1, 1+1, 2+2, 2+2, 1+1, 2+2, 3+3, 0; unguis curving, stout, teeth absent, basally tuberculate. Anal spines 2, 3/4 as long as hind unguis, curved. Maximum length of cotypes, 1.7 mm.....*millsi* n. sp.
Anal papillae reduced to rings; pseudocelli of antennal base 2+2, body pseudocelli as follows: 0, 0, 0, 0, 0, 0, 2+2, 2+2, 0; unguis strongly curving, basally tuberculate, 5 or 6 toothed as follows: paired pseudonychial teeth one-third from the base of the claw, a pair of lateral teeth near the apex of claw, and one or two distal teeth on the outer margin. Anal spines 2, less than half as long as the unguis, almost straight. Maximum length, 4 mm.....*dentatus* Fols., 1902

Onychiurus millsi Chamberlain, n. sp.

Specimen entirely white, postantennal organ elongate, with a great number of closely set papillae. (Fig. 4) Antennae to head diagonal as 5 to 9; segments in the following proportions: 29:40:41:66. Third antennal segment organ (Fig. 7) with 5 slender papillae, finely tuberculate, 5 guard setae, a pair of slender, fusiform sense rods, and two papillae sense clubs. Unguis (Fig. 2) curving, stout, teeth absent, praetarsus tuberculate. Unguiculus untoothed, weakly lamellate on the proximal third, acuminate distally and one-half as long as the unguis (inside measurement). Tenent hairs absent. The pseudocelli visible from the dorsal view (Fig. 6) are as follows: Antennal base, 2-2; back of head, 0-0; prothorax, 0-0; mesothorax, 1-1; metathorax, 1-1; Abd. I, 2-2; Abd. II, 2-2; Abd. III, 1-1; Abd. IV, 2-2; Abd. V, 3-3; Abd. VI, 0-0. In addition the mesothorax, metathorax, Abd. III, and Abd. IV have one lateral pseudocellus on each side. Anal horns 2, (Fig. 3) about 3/4 as long as hind unguis, curved, with prominent, separated papillae. Clothing of body consisting of sparse short setae with a sprinkling of longer setae, about twice the length of the short ones. The anal segment is characterized by more numerous long setae than the rest of the body (Fig. 5). The supra-anal lobe is rounded. Total length, not including antennae, 1.6 to 1.7 mm.

Onychiurus millsi n. sp. keys out quite close by to *Onychiurus dentatus* Folsom since the postantennal organ and third antennal segment organ of these two forms are quite similar, and both have pseudocelli of antennal bases 2-2. *O. millsi* differs from *O. dentatus*, however, by lacking teeth on the unguis and by having prominent anal papillae,

while the anal papillae of *dentatus* are reduced to rings. The body pseudocelli of the two species also differs in position and number.

This new species was described from about thirty specimens collected by R. L. Post in leaf mold, Glen Harbor, Portland, Oregon, January 28, 1940. Cotypes are in the collections of Dr. H. B. Mills and the author.

Onychiurus irregularis Chamberlain, n. sp.

Body color white; eyes, furcula absent; tenent hairs absent. Postantennal organ (Fig. 9, 10) in specimens examined of nine simple tubercules, more or less parallel to the long axis of the organ, showing lateral grooves which taper toward point of attachment of the tubercules and give an irregular appearance to them. Postantennal organ partially or entirely concealed in a deep fold, but may be brought into full view by careful heating in lactic acid.

Antennae about 3/4 to 5/6 of the head diagonal, segments 1 to 4 in the proportions 9:12:14:19. 3rd antennal segment organ (Fig. 13) with 5 tuberculate papillae, 4 guard setae, a pair of sense rods, and two coarsely tuberculate sense clubs.

Dorsal pseudocelli (Fig. 11) as follows: Antennal bases, 1-1; base of head, 0-0; prothorax, 0-0; mesothorax, 1-1; metathorax, 2-2; Abd. I, 1-1; Abd. II, 1-1; Abd. III, 1-1; Abd. IV, 1-1; Abd. V, 2-2; Abd. VI, 0-0; pseudocelli of the metathorax and Abd. V in oblique pairs.

Unguis (Fig. 8) rather heavy, curved, untoothed. Unguiculus slender, .6 as long as unguis (inside measurement); basal half weakly lamellate, apical half acuminate. Tenent hairs absent. Anal horns two, (Fig. 12) a little shorter than the hind unguis, or prominent, divergent papillae. Furcula absent.

Body clothing comprised of sparse, short, simple setae, longer on the anal segment. Integumentary tubercules rather large. Total length of specimen varies from 2.0 to 2.2 mm., not including antennae.

This species resembles in many respects *Onychiurus cocklei* Folsom. The main differences are that the claw is more curved dorsally; the pseudocelli are 2-2 on the metathorax instead of 1-1; the tubercules of the postantennal organ are furrowed on the sides; the postantennal organ is partially or entirely hidden in a fold; and the yellow coloration usually possessed by *O. cocklei* is absent. Described from about 40 cotypes collected under strawberry plants at Gerrais, Oregon, February 25, 1937, by Mr. R. L. Post. Cotypes in collections of Dr. H. B. Mills and the author.

Isotoma spatulata Chamberlain, n. sp.

Ground color white, with sparse, light blue, punctiform pigment on base of head and on dorsal and pleural regions of mesothorax, metathorax, and Abd. I, II, III, and IV. Pigment heavier on head and thoracic segments than on the abdominal segments. (Fig. 26) Eyes absent; postantennal organ close to base of antenna (about 1 1/2 narrow widths of postantennal organ from base of antenna);

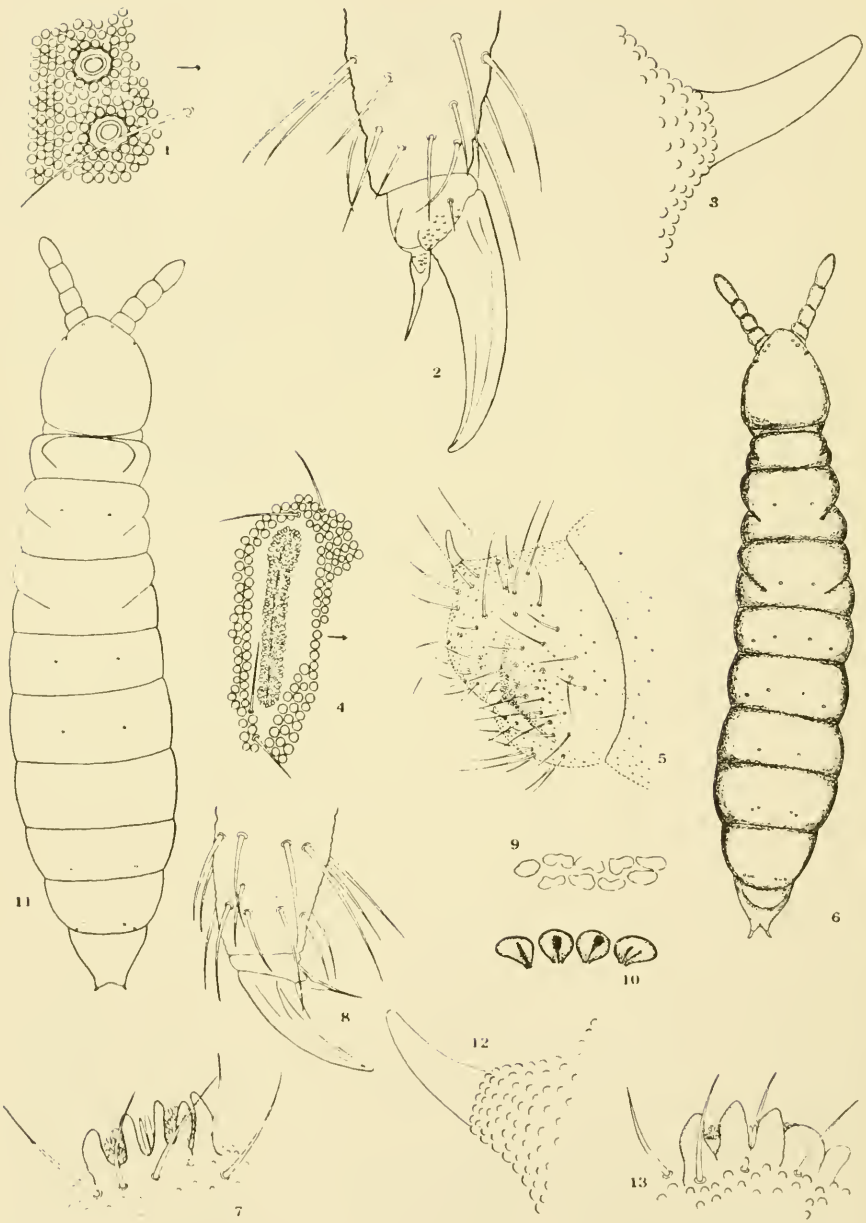

PLATE I

EXPLANATION OF PLATES

Plate I

Onychiurus millsi n. sp.

Fig. 1. Pseudocelli, 4th abdominal segment, X 487.
Fig. 2. Left hind claw, lateral view, X 487.
Fig. 3. Anal horn, X 487.
Fig. 4. Postantennal organ, X 487.
Fig. 5. Anal segment, lateral view, X 105.
Fig. 6. Entire specimen, dorsal view, X 47.
Fig. 7. 3rd antennal segment organ, X 686.

Onychiurus irregularis n. sp.

Fig. 8. Left hind claw, lateral view, X 334.
Fig. 9. Postantennal organ, X 686.
Fig. 10. Tubercles of postantennal organ, lateral view, X 1050.
Fig. 11. Entire specimen, dorsal view, X 43.
Fig. 12. Anal horn, X 334.
Fig. 13. 3rd antennal segment organ, X 487.

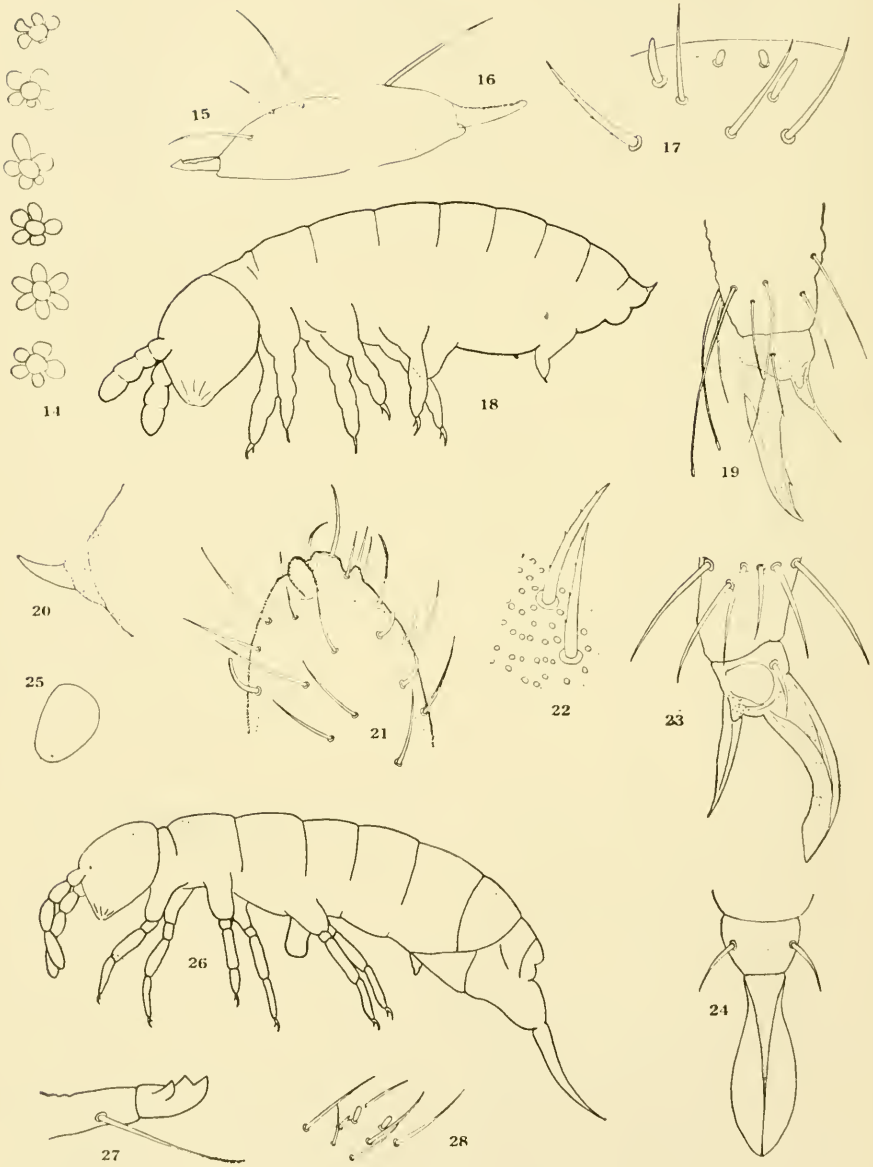

PLATE II

EXPLANATION OF PLATES

Plate II

Achorutes thomomys n. sp.

Fig. 14. Views of postantennal organ showing variations, X 945.
Fig. 15. Mucro, three-quarter view, X 652.
Fig. 16. Mucro, lateral view, X 945.
Fig. 17. 3rd antennal segment organ, X 945.
Fig. 18. Entire specimen, lateral view, X 61.
Fig. 19. Left hind claw, lateral view, X 652.
Fig. 20. Anal horn, X 652.
Fig. 21. Tip of 4th antennal segment, X 652.
Fig. 22. Serrated hairs of 4th abdominal segment, X 652.

Isotoma spatulata n. sp.

Fig. 23. Left hind claw, lateral view, X 675.
Fig. 24. Right mesothoracic claw, inside view, X 675.
Fig. 25. Postantennal organ, X 495.
Fig. 26. Entire specimen, lateral view, X 41.
Fig. 27. Mucro, lateral view, X 675.
Fig. 28. 3rd antennal segment organ, X 675.

irregularly egg-shaped (Fig. 25). The long axis of the postantennal organ is about 1 1/3 times as long as the mucro. Antennae slightly longer than the head diagonal, in the proportions 32:29. Relative length of antennal segments to each other, starting with first segment, 12:18:19:30. 3rd and 4th abdominal segments as 5:4. Genital and anal segments weakly separated. Unguis (Fig. 23, 24) strongly curved, sickle-shaped, without teeth, obliquely truncate apically, and with a greatly developed lateral lamella on each side which gives a spatula-shaped appearance when viewed directly from the inside; except for the lamellae, very finely tuberculate, with heavier tuberculations on the base. Unguiculus approximately 3/4 as long as the unguis (inside measurement) with no lamellae, tuberculate at base. Praetarsal seta present on each side, extending to or slightly past apex of the praetarsus. No tenent hairs present.

3rd antennal segment organ (Fig. 28) with two blunt sense processes, 2.5 to 3 times as long as wide. Furcula apparently appended to the 5th Abd., extending to the posterior portion of the 2nd Abd. segment. Dens to manubrium as 2:1, slender, tapering, finely crenulate dorsally, the crenulations ending the length of the mucro from the apex. Clothing on dens consisting of short, erect setae, with a long sub-apical seta twice the length of the mucro and extending one-third of its length past the end of the mucro. Mucro to dens as 1:28; to hind unguis as 1:2.5. Ventral margin of mucro strongly curved, with a large apical tooth, anteapical tooth approximately the same size, and a proximal tooth, lateral in position, slightly smaller (Fig. 27). Rami of tenaculum quadridentate, corpus with several anterior setae. The body of the insect is covered with plentiful, short, simple setae. Ventral tube basally with two large setae posteriorly and many anteriorly; apically with about ten setae. Total length varies from 1.5 mm. to 1.7 mm. from frons to posterior margin of anal segment.

Isotoma spatulata n. sp. is strongly differentiated from any described species by the following combination of characters: the absence of eyes, the presence of a postantennal organ, and the presence of broad lamellae on the unguis. Linnaniemi, 1912, describes a species from sphagnum moss in Finland which had no eyes, but a large, elliptical postantennal organ was present, and there were no teeth on the unguis. This species, *Isotoma sphagnicola* Linnaniemi, 1912, according to the literature, is one of the closest to *I. spatulata* n. sp., but it lacks the important claw character and is dissimilar in many other respects.

Isotoma minor Schaff. is a tiny white eyeless species, but cannot be confused with *I. spatulata* since *minor's* basic characters are so radically different as to be almost generic. In *I. minor* the postantennal organ is absent as well as the eyes, and elaborate sense organs are present on antennal segment 4.

This new species was described from 8 specimens collected in a colony of *Termopsis angusticollis* Hagen by H. W. Prescott, December 26, 1940 in Eugene, Oregon. Cotypes are in the collections of Dr. H. B. Mills and the author.

TWO NEW SPECIES OF HYPSIGLENA FROM WESTERN NORTH AMERICA[1]

WILMER W. TANNER
In charge of Biological Science
Provo High School, Provo, Utah

During the past few years it has been my privilege to study a large series of snakes belonging to the genus *Hypsiglena*. In starting this study it was the writer's intent to learn more concerning the less common snakes of Utah. As the study progressed a few specimens from out of the state were studied for comparison. These proved so interesting that a study of the genus has since been undertaken. During the course of these investigations it has become apparent that two new species should be recognized from the Pacific Coast area.

Sixteen specimens taken from the north and central sections of California were easily segregated from other forms. A distinctive nuchal blotch readily distinguishes one of the new forms and because of this I have assigned to it the name

Hypsiglena nuchalatus Tanner sp. nov.

Description of the Type, B. Y. U. No. 3008: Total length 175 mm.; tail length 22 mm.; ratio of tail length to total length 12.57 per cent; head length 9.6 mm.; width 5.5; diameter of eye 1.5 mm.; eye to nostril 1.7 mm. The dorsal scales are smooth and in 19-19-17-16 rows. The first reduction to 17 scales occurs on the right side by combining the fifth and sixth rows. The second reduction to 16 scale rows occurs at the 192nd ventral by combining the third and fourth rows. On the tail the dorsals reduce to eleven rows at the second caudal and to six rows at the tenth caudal. There are 196 ventrals, the anal scale is divided, and there are 43 subcaudals. The terminal scale is single and slightly elongated.

The head is 42.5 per cent longer than wide and slightly convex above. The rostral is rounded, moderately pointed, and three times as wide at the base as long, convex above and concave below. Internasal wider than long, prefrontal 1/4 wider than long. Frontal 1/4 longer than wide, its length being less than the width of a parietal. The nasals are divided, and over twice as long as wide, the openings being located near the center but closer to the dorsal suture. Loreal moderate to large, not in contact with the lower preocular, and twice as long as wide. There are two subequal preoculars, the dorsal scale three times the larger. Eye moderate in size, the diameter of orbit equal to one half the distance from eye to tip of snout; two subequal post-oculars, the dorsal scale two times the larger or more. Temporals 1-2-3, the one in contact with the oculars the largest; seven

(1) Contribution No. 103 from the Department of Zoology and Entomology, Brigham Young University.

supralabials in the following order of increasing size 1, 3, 2, 7, 4, 5, 6, the 5th and 6th nearly equal. The first labial extends laterally between the nasal and the second labial to make contact with the loreal; the 3rd and 4th enter the orbit; and the 5th is in contact with the lower post-ocular. Mental moderate in size and only slightly wider than long, the lateral edges curve concavely to form a point which projects part way between the first pair of infralabials. There are ten infralabials, the first pair contact on the mid-ventral line, and the first six pair are in contact with the genials, the sixth pair is the larger; two pair of equal size, nine gulars between the genials and the first ventral, the anterior pair of gulars lies between the posterior chin-shields, but does not completely divide them. There are six gulars between the 9th infralabial and the midventral line.

Color in Alcohol: The upper surface is brownish-gray with a series of large dark brown spots extending from the nape region posterior to the tip of the tail. The spots extend from the 7th to the 13th row, and are two scales in length (a few nearly three); the scales of the spots have a light center with the edges dark brown to black. Those scales between and lateral to the spots are flecked with innumerable small brown spots. Tail spots distinct. Lateral to and alternating with the vertebral spots, is a row of smaller spots on the 4-6 rows (principally on the 5th). Another row of smaller spots opposite the dorsal ones is found principally on the third row. Under parts are white and immaculate.

The head plates are brown with a few dark blotches on the frontal and parietals. There is a large dark brown spot which extends entirely across the nape region, and appears as an irregular band or collar, the band is twenty scales across and at the dorsal nine scales long. The lateral edge of the bar on each side is extended anteriorly across the temporals through the eye to the nasal where it terminates. A few dark markings are present on the labials. Dorsal spots on body, 58, on tail 18.

Dentation: There are four smaller maxillary teeth followed by a pair of large ungrooved fanglike teeth.

Diagnosis: A species of Hypsiglena which differs from *torquata ochrorhynchus* in having a more elongate snout and a narrower head; body and tail spots distinct, and with a dark brown or black bar across the nape region. Dorsal scale formula normally 19-19-17-15 and with only 7-7 supralabials.

Type: A small female collected by Stanley and Allen Mulaik on March 20, 1941, at Lemoncove, Tulare County, California. This specimen, No. 3008, is deposited in the Herpetological collection of the Brigham Young University.

Paratypes: University of California Nos. 19207, 19328, 19329, 19330, Sequoia National Park, Tulare County; 20486, Paynes Creek, Tehama County; 24118, Oroville, Butte County. L. M. Klauber Nos. 20233, 20293, 22501, Visalia, Tulare County; Stanford University No. 8070, Mt. Diablo, Alameda County; and California Academy of Science No. 30876, Contra Costa County. All paratypes have been returned to the above mentioned institutions.

Scalation of Nuchalatus: Scale rows are 19-19-17-15 in 9 specimens, the remaining 7 specimens show formulas varying from

21-19-17-15 to 21-21-19-17-15. In only two specimens is there more than 19 rows at the 100th ventral. The highest of these is 113. In all specimens except the type there is a reduction to 15 rows anterior to the vent. In the type the reduction is only to 16 rows, the one side not reducing; however, the scales do become smaller to accommodate the extra row. In all specimens the apical pit in the dorsals is distinct, but the keeled condition of the scales just above the vent on each side varied from no keels in the type to distinct keels in some of the males. Faint keels were observed in three of the five females and in only one male were they not noticeable.

The ventrals varied as follows: males 179-191, average 184.72; females 195-201, average 197.8; caudals, males 47-53, average 48.1, females 42-46, average 44.4. The ventral-caudal total 226-243 in males to 237-246 in females. The anal is divided in all specimens.

The nasal is large and divided, the suture passing through the nasal opening. The supralabials are 7-7 in all specimens except three which are 8-8. The reduction has produced larger labials with the 3rd and 4th labials entering the orbit, and in several specimens the first labial is in contact with the loreal, in those specimens in which contact is not made the two scales are very near each other. The infralabials are 10-10, loreal 1-1 except three specimens which have 1-2; oculars 2-2, two specimens have only one preocular on one side; temporals 1-2-3.

The head is proportionately longer and narrower than other species which I have studied. This fact is emphasized by the elongate rostral which projects well beyond the mental.

In general the color pattern is much the same. The dorsal spots range from 45-61 in males and 51-67 in females, those specimens with more than 19 scale rows have three lateral rows of spots, those with only 19 rows have 2 lateral rows of spots. All spots are distinct. This is not the case in most specimens studied from adjoining areas in which the tail spots are often indistinct. The nape region is covered by a dark nuchal blotch which is 8 or 9 scales long at the dorsal and which extends laterally to within 2-4 scales of the ventrals. The lateral edge of the nuchal blotch extends anteriorly to the orbit, and dorsally it projects forward to contact the parietals. In a few specimens the lateral projection is divided posterior to the supralabials. There is no light nuchal band separating the head plates from the nuchal blotch. Those dorsal scales anterior to the nuchal blotch are the same color as those posterior to it. Except for a few flecks on the genials and lower labials of some specimens the under parts are white.

Range: Thus far this species has been taken only along the western slopes of the Sierra Nevada Mountains from Tulare County in the south to Tehama County in the north. It appears to extend well up the slope of the mountains as well as down into the San Joaquin and Sacramento Valleys. Extensive collecting will undoubtedly extend its range to the north and west.

Relationship and Intergraditions: *Nuchalatus* seems to represent an offshoot of the more wide spread species *ochrorhynchus*. Intergrades are available from three localities, LMK. 8792, Limon, Kern County; MMZ. 78234, 60 miles west of Maricopa, Santa Barbara County, California, and SU. 1214, Los Gatos, Santa Clara County, California. In all specimens the color pattern is more like that of *nuchalatus* than *ochrorhynchus*. The Limon specimen is similar also in that the dorsal rows reduce to 19 at the 98th ventral, otherwise it is more nearly like *ochrorhynchus*. The Santa Barbara specimen has only 7 supralabials as does *nuchalatus*, otherwise it is like *ochrorhynchus*. The scalation of the Los Gatos specimen, except for the ventral-caudal counts, is strikingly similar to *ochrorhynchus*. To date too few specimens are available from the areas of intergradation to complete the picture. It seems logical to expect the *nuchalatus-ochrorhynchus* intergrades to appear in Kern and Santa Barbara Counties. It is possible, however, that intergradations will appear farther north along the coast.

Remarks: In 1938 Mr. L. M. Klauber in discusisng "The Subspecies of the Spotted Night Snake," said "It is true that there is an evident correlation between habitat and scale counts, desert areas producing a higher ventral count than more humid regions." While this appears to be the case with *ochrorhynchus* in southern California, it is not true of *nuchalatus* in which the highest counts occur in specimens collected higher on the slopes in the more humid regions. Specimens collected on the desert side of the Sierra Nevadas (Mona and Inyo Counties) have lower count than *nuchalatus*. Other genera are known to produce higher or lower ventral counts as one moves east from the Pacific Coast. Van Denburgh and Slevin in 1919 showed that *Pituophis* increased from west to east, while V. M. Tanner, 1933, found *Charina* to decrease from west to east. Just why two species of *Hypsiglena* should show such an arrangement is not clear at this time.

The sexual dimorphism is very distinct in *nuchalatus*. In no instance was there any overlapping of ventral counts. In fact, four scales separated the highest male (191) from the lowest female (195).

The largest specimen is a male measuring 352 mm.; the smallest is a femae measuring 160 mm.; the average length for the entire group (male and female) is 253.81 mm. A series of 88 specimens from the Great Basin produced an average of 322.56 mm., 52 Arizona specimens average 322.11 mm., 82 specimens taken on the Pacific side of San Diego County average 273.34 mm. While there are insufficient specimens available to arrive at any conclusions, it does appear that *nuchalatus* is a smaller species than those forms to the east and south.

Hypsiglena slevini Tanner sp. nov.

Description of the Type: Total length 217 mm., tail length 41 mm., ratio of tail length to total length 18.9 per cent; head length 11.7 mm., width 7.2 mm.; diameter of orbit 2.3 mm.; orbit to nostril 1.8 mm. The dorsal scales are smooth each bearing a single apical pit and in 21-23-21-19-17-15 rows, 23 rows extend from the 38th to the 114th ventral. There are 190 ventrals; the anal scale is divided and there are 68 subcaudals.

The head is 38.4 per cent longer than wide, rounded anterior to the eyes and flat posteriorly across the parietals; the supraoculars are slightly elevated producing a concave condition between the eyes; the rostral is blunt, not wedging between the internasals nor extending far beyond the mental; from a dorsal view it is seen as a very narrow scale extending across the snout. Internasal nearly square widest posteriorly, prefrontals much wider than long, the lateral suture level with the nasal opening; the frontal is twice as long as wide, widest at the anterior, narrower at the center between the eyes. Parietals large and in contact with both postoculars. Nasal plate divided, the posterior scale the larger. Loreal single and moderate in size; two subequal preoculars, the dorsal scale is three times wider than long, lower small and wedged between the third and fourth labials; eye large; postoculars 2-2, the dorsal scale the larger; temporals 1-2-4. Supralabials 8-8, in the following order of increasing size 1, 2, 3, 4, 5, 8, 7, 6; the fourth and fifth enter the orbit. Infralabials 10-10, the first pair in contact on the mid-ventral line, the sixth largest; mental moderate in size, triangle shaped; two pair of genials the posterior pair longer; six gulars between the posterior genial and the first ventral.

Color in Alcohol: The upper surface is cream color with a series of brown spots extending from the nape to the tip of the tail. The spots extend across the body from the 8th to the 16th dorsal row and are two scales in length; the scales of the spots are, except for a dark spot on the apex, uniformly brown; between the spots the scales are free from color markings except for an occasional patch of small flecks. Lateral to the dorsal spots are three rows of smaller brown spots, alternating with the dorsal row and each other. The rows of spots are found on the following dorsal scale rows, first row 1-2, second row 2-4, third row 5-7; the scales lateral to the dorsal spots have considerably more flecking than those scales between the spots; the tail spots are distinct. Body spots 52, tail spots 26, under parts cream to straw color and without markings.

The head plates are mottled, with no definite arrangement or markings. The nape region is distinctly spotted, with two large dorsal posterior spots nine scales

long, and six wide at the anterior; three smaller dorsal anterior spots which are as wide as long, and two lateral spots which extend from four scales posterior to the labials anterior to the eye. The sutures of the supralabials anterior to the eyes are dark; the lower labials have smaller dark patches.

Dentation: There are five smaller maxillary teeth followed by two ungrooved fanglike teeth.

Diagnosis: A *Hypsiglena* characterized by a high ventral and subcaudal count, and by the parietals contacting the lower postoculars. The snout is blunt and the eye is large. The color pattern is also distinct.

Type: California Academy of Science specimen No. 53631, a male collected by Joseph R. Slevin, June 14, 1921 at Puerto Escondido, Lower California.

Remarks: So distinctive are the head plates in this species that little difficulty should be encountered in separating it from other species. Also in this species the subcaudal count is higher than in any other species examined.

It is a real pleasure to name this snake for Mr. Joseph R. Slevin.

Acknowedgment: I wish to thank the following individuals and institutions for the loan of material and notes used in this report: Mr. Thomas L. Rodgers, Museum of Vertebrate Zoology, University of California; Mr. Joseph R. Slevin, California Academy of Science; Mrs. Helen T. Gaige, Museum of Zoology, University of Michigan; Dr. George S. Myers and Mr. T. Paul Maslin, Natural History Museum, Stanford University; Mr. L. M. Klauber, Zoological Society of San Diego, and Mr. Stanley Mulaik, University of Utah.

It was my good fortune to receive the notes and scale counts made by Messers. Hawkens and Regneri while they were working at Stanford University. I wish to acknowledge their usefulness in this study.

I am indebted to Mr. Stanley Mulaik for providing me with the type specimen of *nuchalatus* and to Dr. Vasco M. Tanner of the Brigham Young University Zoology Department for aid and providing me with the necessary facilities for study.

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The Hawthorn, Crataegus colorado, a New Record for Utah

On September 9, 1941, Louise Atkinson and I discovered a hawthorn new to Utah's known flora, growing on the north side of Provo Canyon at an altitude of 5200 feet, at a point about one quarter mile up the main canyon from the entrance to Timpanogos drive. Miss Atkinson caught a glimpse of its scarlet berries as we drove towards it, and upon investigating we found it had thorns four inches long.

That afternoon we submitted the specimen to Prof. A. O. Garrett, but he like ourselves was puzzled; for the genus *Crataegus* is so highly critical one must have many comparative specimens for final determination. Accordingly the next day we sent the branch to the National Herbarium which forwarded it to the Arnold Arboretum at Harvard. It was there thought to be either a new species or one so close as to require both spring and fall specimens. Since that time we have forwarded many specimens, and we have just received word from Mr. Ernest J. Palmer that it has finally been designated as *Crataegus colorado* Ashe.

Mr. Palmer makes these observations.

"This plant is certainly very different from *Crataegus rivularis*, the only species of which we had specimens from your region. From characters shown by both the flowering and fruiting specimens, and particularly from the nutlets of the fruit, it seems to belong definitely in the section *Macracanthae*. This section is represented in the Rocky mountain region by *Crataegus occidentalis* Britton and by *C. colorado* Ashe, the types of which came from Colorado.

"In Rydberg's Flora of the Rocky Mountains and adjacent plains you will note that both *Crataegus occidentalis* and *C. colorado* are given as synonyms of *C. succulenta*. I scarcely feel that such a combination of things that typically appear so distinct is justified, and we have kept both of them separate in this herbarium. Your plant too looks rather distinct from either in its relatively smaller and narrower leaves and in its rather smaller flowers. But it seems to me that it comes too near to *C. colorado* to be considered a distinct species. The differences that it shows may be accounted for possibly as the result of varied ecological conditions. Many new species were recognized and described by Ashe, Sargent and others about the beginning of the century that were characterized by no better distinctions than can be found in this plant. But in a genus like *Crataegus* it is my feeling that it is advisable to be very cautious and that new species should be named only where the distinguishing characters are very clear and, generally, where a number of individuals are known for comparison. However, it is an interesting discovery and it extends the range of *Crataegus colorado* to Utah where species of the genus are very scarce, and only one *C. rivularis*—was definitely known before."

Since discovering the original tree Miss Atkinson and I have found more than twenty other similar trees in the same locality, all within a hundred yards distance. The original tree actually hangs over the very edge of the highway, and in the past decade probably half a million people have passed within ten feet of it.—Claude T. Barnes, 359 Tenth Avenue, Salt Lake City, Utah.

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CALIFORNIA GULL

A Comparative Plumage Study*

D. ELDEN BECK

Assistant Professor of Zoology and Entomology
Brigham Young Uninversity

In a recent article Brooks[1] described and illustrated the plumage changes of the California gull, *Larus californicus* Lawrence. His study was made from the observation of gulls in the field and from skins taken from birds under normal conditions.

Dwight[2] in his monumental work on the gulls of the world briefly describes the appearance of the first winter (non-nuptial) bird and second summer plumages. Dwight's second summer description is listed as, "first nuptial plumage" in his writings.

The following remarks on plumage are about the changes taking place in the first winter, and second summer birds, as observed in captivity by the author.

One of the specimens under study was hatched in an incubator and its exact age is known. All other birds used in this study were captured at Rock Island in Utah Lake, Utah. A large colony of California gulls breeds at this island and then migrates in late September and early October, to the Pacific Coast. The birds, with the exception of the incubated chick, were captured a few weeks before migration took place. All birds were in complete juvenal plumage.

The birds in captivity were fed hamburger once to twice a week. In addition, corn (cooked), vegetables of various kinds, and bread were added to the diet. The pen was 8x8 feet square and 5 feet high. A short screened runway was connected to the pen. The runway

* Contribution No. 105.
1 Brooks, Allan, 1943. The Status of the California Gull. Auk, Vol. 60, No. 1, pp. 15-20.
2 Dwight, Jonathan, 1925. The Gulls (Laridae) of the World. Bulletin American Museum of Natural History, Vol. 52, pp. 198-199.

was 10 feet long, 4 feet wide and 5 feet high. The birds were exposed to all changes of weather and thus were subject to the continual effect of outdoor conditions.

Under normal conditions, where the gulls are at their winter residence somewhere along the Pacific coast, marked changes in plumage are taking place. It seems that, in order to gain a complete story of plumage change in the California Gull, under natural conditions, after it has departed from its breeding grounds, it will be necessary to carefully study banded birds. In anticipation of this, banding of California Gulls has been done at Rock Island each spring since 1940.[3&4] However, in order to observe the plumage change even under abnormal conditions, birds kept in captivity were selected for study.

FIRST WINTER PLUMAGE

Dwight's[5] reference specimen is a bird collected November 11, 1912 at Pacific Grove, California. Brooks[6] does not list a winter bird as such in his description although he has an illustration of a 10-month-old specimen, collected April 26, 1923 at Buena Vista Lake, California. He calls this the "first spring plumage." Dwight's description is of a bird at the beginning stage of winter plumage while Brook's description is for the terminus of winter plumage.

In order to get the comparative colors and patterns for these two birds I quote from Dwight[7]:

> Acquired by a partial post juvenal moult in September and October. Back paler and grayer than the juvenal, with less mottling, and the barring of a paler brown, more fused and diluted. Head dark and heavily streaked, a trifle paler than the juvenal. Underparts paler than the juvenal on chin, throat and breast. Wear brings into prominence the barrings and mottlings through loss of feather edgings, producing a spottiness. Wings and tail of juvenal plumage retained. Bill and other soft parts much like the juvenal.

Brooks[8] describes the characteristics of a ten-month-old bird as follows:

> The drab gray black is replaced by blue-gray feathers only slightly duller than the mantle of the adult; the head and breast turn whiter but the primaries and rectrices are retained; the secondaries and tertials are usually very abraded, and the latter are reduced to filaments as the season progresses; the feet are turning from flesh to bluish.

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3 Tanner, V. M., 1941. Gull Banding Notes on Utah Lake. Great Basin Naturalist, Vol. II, No. 2, pp. 98.
4 Tanner, V. M. and Beck, D. Elden, 1942. Gull Banding Notes on Utah Lake. Great Basin Naturalist, Vol. III, pp. 55-57.
5 Dwight, Jonathan. Ibid.
6 Brooks, Allan. Ibid.
7 Dwight, Jonathan. Ibid. p. 198.
8 Brooks, Allan. Ibid. p. 17.

In the study of the birds in captivity it was evident that both color and color pattern were undergoing change from month to month.

At the end of the eighth month (last of January) many changes have taken place in the detail of color and pattern in captive birds. In general the whole body color tone tends to be darker. This is distinctly seen in the wing region.

The primaries have lost the light colored tip seen in the juvenal and the whole feather vane is a deep brown to black color. The primary coverts are similar in color to the primary feathers but have a narrow, light colored, distal band. The greater, medial and lesser coverts are dark cinnamon to brownish with tawny to grayish borders.

The head, as viewed dorsally, is predominantly cinnamon with slate colored streaks subdued. The neck is primarily cinnamon color.

In the region of the axillaries and the back, the greatest change has taken place. The axillaries have a barred effect much subdued by a grey color. The pattern effect of the juvenal has changed from a barred effect to one of mottling in the month-old bird. Some of the feathers in the back and axillary region are a solid pearl-gray color.

The upper coverts are similar to the juvenal, but are more elongated. The pattern of the individual feather in the upper tail coverts is cinnamon while in the juvenal it is a deep brown to black.

The tail feather vanes are terminally tipped with white. Next to this is a dark band, brown to black in color. Next is a narrow white band. With the exception of the two outside feathers, the remaining part of the tail feather is solid black to deep brown. The two outside feathers are barred or mottled light and dark.

Viewed from the venter, the wings are slate-colored and almost a solid tone. The breast is darkly mottled and streaked a dull grey. Proceeding posteriorly and ventrally the color tends to become lighter. The under tail coverts are distally barred. The medial under tail coverts are as long as the medial tail feathers.

The ten-month-old gull in captivity varies from the eight-month-old bird in the following respects: The head (dorsally) is lighter in color but still predominantly brownish. Neck region almost a solid brown. (Examination of an individual feather shows the proximal part to be white and distal part solid brown). Anterior, dorsal feathers on back are slate color. Main region of back and upper tail coverts, barred and mottled a grey and deep brown. Anterior axillary feathers deep brown and faintly patterned. Throat region much lighter. In some specimens the throat region is almost white. Whole under body color is a lighter tone than in the eight-month-old gull.

SECOND SUMMER

Dwight's[9] "first nuptial plumage" is the nearest description he gives to what I call the second summer plumage. His reference specimen is one taken at Big Stick Lake, Saskatchewan, Canada, July 18, 1906. His description is as follows:

> Acquired by a partial prenuptial moult in March and April. Wings and tail of the juvenal plumage still retained. Back like the first winter, but rather paler and with diminished central areas on the new brown feathers, some grayish. Head much like the first winter but rather pale. Underparts rather paler than the first winter, the chin and throat largely white. Bill and other soft parts much like the juvenal.

Brooks[10] does not describe the plumage for the second summer bird in his discussion.

The birds in captivity, fourteen months of age, are lighter throughout the whole body color than any age previous. Although the general pattern may be retained in the wing region, the tone of color is decidedly lighter. Many feathers on the dorsum are solid grey. The median and lesser wing coverts have unevenly distributed cinnamon and pearl grey feathers. The bill at its terminus has a light colored tip with a broad black to deep brown band. The main region of the bill is cream to yellow. The eye is solid black.

In late summer (September) the color tone of the head and the neck region tends to become darker than that of the earlier months. The greater coverts are lighter and more uniform in color. The color tone is near that of the pearl grey mantle of the adult. The anterior feathers on the back are predominantly grey. Posterior feathers are light brown and grey mottled. The tail feathers are basally mottled dark and light, distal half being black. The outside tail feathers are pure white on the inner side of each vane except the tip which is black. The outer part of the vane is mottled its full length.

This brief comparative study can probably be summarized appropriately in two statements recently seen in two published accounts:

Bissonnette[11] speaking of photo periodicity as it affects pelts of animals says, "This all points to the necessity of using animals from one locality and similar in normal behavior for experimental studies of this sort, lest differences in normal behavior carry over into the experimental results."

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9 Dwight, Jonathan. Ibid. p. 199.
10 Brooks, Allan. Ibid. p. 17.
11 Bissonnette, 1943. Some Recent Studies on Photo Periodicity in Animals. Transactions of the New York Academy of Science, Series II, Vol. 5, No. 3, p. 47.

Brooks[12] says, "No family of birds is so badly in need of correlated research in field and study as the gulls, especially in America."

It would appear that the only way to obtain an accurate, complete plumage story is through a study of banded birds under their normal environmental conditions.

12 Brooks. Ibid. p. 19.

The Mexican Bean Beetle, Epilachna varivestis Mulsant, Does Damage in Utah in 1943

This lady-bird beetle, which feeds upon plants, especially beans, has become well established in Utah Valley. It was first reported as occurring in Utah in 1922[1] and in Utah County in 1939[2]. During the past summer it has done considerable damage to the bean crop of this valley. This beetle passes the winter only in the adult stage, hibernating under leaves, weeds and along ditch banks. It does not emerge until late spring, and very few eggs are found before the first of July. By the middle of July the larvae are about half grown and are doing much damage by eating the leaves of beans. The larvae are oval, yellow, spine-covered creatures, which grow to 1/3 of an inch in length in about four weeks. Pupatation then takes place on the underside of the bean leaves. Only one generation of importance has been observed here in the Provo area.

This species may be effectually controlled by using any one of a number of sprays or dusts. Apply fresh, high-grade insecticides to the leaves of the beans. It is important that the dust or spray covers the underside of the leaves, if the control is to be successful. Applications of the insecticide should be made every 10 days from the time the eggs are observed until about the middle of August.

Because of the damage that this pest may do it is important that Crop Pest Inspectors, Agricultural Agents and truck gardeners of this area be familiar with this insect as well as methods of its control.—V. M. T.

1 Tanner, Vasco M., 1929, **Pan-Pacific Entomologist,** Vol. V, pp. 183-86.
2 1940, **Great Basin Naturalist,** Vol. I, No. 2, p. 91.

OBSERVATIONS ON THE ECOLOGY AND NATURAL HISTORY OF ANURA XV. THE HYLIDS AND MICROHYLIDS IN OKLAHOMA[1]

ARTHUR N. BRAGG

When the studies which are resulting in this series of papers were initiated, so little was known about the amphibian fauna of Oklahoma that the problems involved were attacked from practically all viewpoints at once. From the beginning, all phases in the lives in nature of any and all species present were observed at every opportunity rather than concentrating on any one phase or any one species first.

From necessity, this method has resulted in papers with several different emphases. Some have been largely ecological in nature; others have dealt with one species from the viewpoint of habits and distribution; while still others have been centered on some one phase of the lives of one group of species as contrasted with another in a different ecological community within the same general geographical range.

In general, problems in classification have been given little emphasis, for the taxonomic relationships of most of species in Oklahoma have been well worked out. An exception to this was found in the genus Scaphiopus and the paper on that group attempted a summary of classification as well as taxonomic relations expressed as a phylogenetic tree. The present paper constitutes another such exception, for its discussion includes one genus, Pseudacris, which has always been confused.

The conceptions expressed are based upon observations in Oklahoma during the past seven years (1936-1942 inclusive), modified in interpretation, of course, by a close study of all literature available. The paper deals with the hylid frogs primarily but includes observations upon the single microhylid present in the Oklahoma fauna, *Microhyla olivacea* (Hallowell).

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1 Contributions form the Zoological Laboratory of the University of Oklahoma. Aided in the earlier phases by a grant from the Faculty Research Fund of the University. Finished through a Grant in Aid of Research from the American Association for the Advancement of Science.

tangible and intangible. My greatest indebtedness is to my former colleague and collaborator, Dr. Chas. Clinton Smith, who worked with me during the earlier years in all parts of Oklahoma; to Dr. A. O. Weese for critical advice and suggestions particularly in ecological matters; and to Dr. A. I. Ortenburger for loans of literature, use of specimens, and criticism in herpetological matters.

TAXONOMY

The following taxonomic arrangement is the one adopted.

Class Amphibia
- Order Salientia (Anura)[2]
  - Suborder Procoela
    - Family Hylidae
      - Subfamily Hylinae
        - Genus Hyla
          1. *H. versicolor versicolor* Le Conte (1825)
          2. *H. crucifer crucifer* Wied (1834)
          3. *H. cinerea cinerea* (Schneider) (1799)
        - Genus Pseudacris
          1. *Ps. clarkii* (Baird) (1854)
          2. *Ps. triseriata* (Wied) (1838)
          3. *Ps. streckeri* Wright and Wright (1933)
        - Genus Acris
          1. *Acris crepitans* Baird (1854)
  - Suborder Diplasiocoela
    - Family Microhylidae
      - Genus Microhyla
        1. *M. olivacea* (Hallowell) (1856)

In general, this follows the outline given by Stejneger and Barbour (1939) except in Pseudacris where my observations confirm those (e.g. Smith, 1934) who separated specifically *Ps. clarkii* (Baird) from both *Ps. triseriata* (Wied) and *Ps. nigrita* (Le Conte). The evidence for this view will appear later in the discussion.

KEY TO THE ADULTS OF THE ABOVE FORMS IN OKLAHOMA[3]

1. Toes with discs; webbing of hind toes varying in amount but always present; teeth in upper jaw.....2

1. Toes without discs; webbing and teeth absent..*Microhyla olivacea* (Hallowell)

2 **Salientia** is clearly the preferred ordinal name; when the title of this series was chosen some years ago this was not recognized; accordingly the name Anura is retained in the title only for consistency, inasmuch as to change the title in the middle of the series would seem to be more confusing than the relatively minor point of using a less preferred, but easily understood, synonym.

3 Partly from the literature cited but modified by examination of several hundreds of specimens collected personally in Oklahoma.

2. Toe discs small and inconspicuous (Acris and Pseudacris).....3

2. Toe discs not particularly small and inconspicuous (Hyla).....6

3. Toes extensively webbed.....*Acris crepitans* Baird

3. Toes not extensively webbed (Pseudacris).....4

4. Body slim; nose pointed; hind legs long; fingers long.....5

4. Body short and toadlike; hind legs short; fingers quit short; nose rounded.....*Pseudacris streckeri* Wright and Wright

5. Color variable, typically gray or brown with dark stripes down the back, with a prominent light line along the jaw, and with no triangular mark dorsally behind the eyes (rare exceptions).....*Pseudacris triseriata* (Wied)

5. Color also variable, typically gray with small green or darker spots on back; either with no light line or only an inconspicuous one along the jaw; dorsal triangular mark back of eyes typical.....*Pseudacris clarkii* (Baird)

6. Size larger (37-63 mm.); color variable from nearly black to bright green, the green phase the usual one; no special X-like mark on back; skin smooth or only little roughened; a light line along upper jaw and extending about half way down side; body slim and hind legs very long .....*Hyla cinerea cinerea* (Schneider)

6. Size smaller (18-60 mm.); color also variable from nearly black to green but with gray coloration the usual one; skin tends to be granular; no light line along side; and X-shaped mark on back, present in most color phases 7

7. Body size approximately 18-33 mm.; X-shaped mark, thin-lined and regular.....*Hyla crucifer crucifer* Wied

7. Body size approximately 32-60 mm.; X-shaped mark heavy-lined and often irregular in outline.....*Hyla versicolor versicolor* (Le Conte)

Hyla versicolor versicolor (Le Conte) (Common Tree Toad)

The geographic range of *H. v. versicolor* is given by Stejneger and Barbour (1939) as, "Maine, southern Canada, west to Minnesota, south to the Gulf States and to Ocklawaka swamp in Florida. Texas and Arkansas in part only." Its range extends westward to eastern Kansas (Smith, 1934) and it is present in the central cross timbers of Texas where I have heard its call from oaks at night some forty miles north of Dallas while travelling U. S. Highway 77.

It has been known from eastern Oklahoma for some years but its extension westward within the state has been somewhat uncertain. I have specimens from each of the following counties which appear to be new records: Osage, Mayes, Garvin, Murray, Pontotoc, Love, Coal,

Atoka, Choctaw, Latimer, and Sequoyah. In addition, I have heard its characteristic call in Pittsburg, Huges, Seminole, and Carter counties, in all of which it apparently has not yet been collected. Adding the nine other counties in which it has been reported already to these new records gives a total of twenty-six counties, all in the eastern half of the state, in which the species is known to occur. Of this total, five records are based upon calls heard, twenty-one on specimens collected. Fifteen of the total are apparently new records.

In general terms, *H. v. versicolor* is dependent upon the presence of trees for a suitable habitat and usually the trees must be present in abundance. However, in Oklahoma it is common in dry woodlands and savannahs and not limited to ravines and water courses as might be expected from observations farther north and east (see Smith, 1934, and the literature cited there). Whereas the largest breeding congress of this species which I have ever seen was present along a wooded creek in southeastern Oklahoma, nevertheless, medium sized congresses have been frequently studied several miles from permanent water courses in dry woods about temporary pools. Flood plain forests of the larger rivers form a highway for its dispersal to the westward in southern Oklahoma (e.g. to western Garvin county along the Washita and at least to western Love county along the Red). But from McClain county northward these animals apparently fail to follow the rivers westward to any extent. In western Cleveland county, for example, they have never been found along the Canadian River where its flood plain forest extends westward into the mixed grass prairie, although they are very abundant only seven miles eastward across the prairie where the oak-hickory woodland-savannah begins (see Bragg, 1940, for a map of this region). On the other hand, stray individuals do follow wooded ravines into the prairie; one calling male was taken at a prairie pool, one mile from the western edge of the woodland and two others have been collected in Norman, four miles from the woodland-savannah.

The breeding habits of the common tree toad in Oklahoma are essentially as elsewhere. They begin breeding early in the spring (Bragg and Smith, 1942) and continue intermittently till midsummer, the exact dates usually depending upon rainfall. They, therefore, have a breeding season somewhat independnt of rain for its beginning but are stimulated then as well as later by any rain which comes. They seldom call or breed at temperatures of 10°C. or below even after heavy rains in springtime.

The call has been described as variable. I find this to be true but have noted also that it tends to follow either one of two distinct patterns. One of these is a short, hoarse trill, varying in pitch among individuals and tending to be lower with increasing size. This is always given with the gular pouch extended and with little muscular movements of the abdomen and lateral regions. The other is a shorter, "fussy," "yip, yip, yip," etc., given without use of the gular pouch and with violent contraction of the body muscles with each note. The first type of call is the more common and may be heard from trees far from water as well as in breeding aggregations. The second is more often heard as a "protesting note" when the animal is confused or disturbed without being unduly frightened. However, one individual under observation which sat at the edge of a breeding pool "yipping" persistently, suddenly, and with no apparent reason, changed to the more typical short trill.

Wright (1929) stated that fully developed tadpoles of this form had a vermillian coloration to the tail fin. I have observed this on thousands of individuals taken or seen in Oklahoma. However, apparently no one has emphasized that the reddish color does not occur till late in aquatic life. Young tadpoles of *H. v. versicolor* when seen in their native pool look and behave so much like those of *Ps. streckeri* (Bragg 1942c) that one often cannot distinguish between them without close examination. They can always be distinguished in the field, however, if close attention be given to the coloration of the tail. That of *Ps. streckeri* always remains clear and essentially unpigmented. That of *H. v. versicolor* early develops black streaks, especially dorsally, which increase in numbers and may take the form of a dark fringe along the dorsal surface of the posterior part of the tail fin. The reddish color mentioned by Wright develops gradually during the last two weeks or so before metamorphosis at which time the tail appears higher and more ruffled than that of *Ps. streckeri.*

The young, after metamorphosis in Kansas stay, about pools and streams (Smith, 1934). In contrast, in Oklahoma I have never found them in such situations. In one case, for example, hundreds of thousands of tadpoles were being watched in a large pool among a heavy growth of oaks. On one visit in late June, 1942, it was apparent that most of them were approaching metamorphosis. A week later, no tadpoles could be found in the pool and a diligent search for an hour along the shore turning over objects and searching among the trees, failed to reveal a single specimen. From this experience, I thought it probable that the young animals had scattered widely in the trees

even though the weather was hot (90°F. and above each day) and the woodland extremely dry. One wonders how such young and delicate amphibians avoid death under such conditions as these.

Hyla crucifer crucifer Wied (Spring Peeper)

The range of the spring-peeper given by Stejneger and Barbour (1939) includes nearly all of the South and East. Smith (1934) says that they are limited to the easternmost region of Kansas. They are present in Arkansas and Louisiana (I have seen specimens from the latter state) but Wright and Wright (1938) fail to mention this form in Texas.

In Oklahoma, they are known certainly from only one county, McCurtain, in the extreme southeast (Trowbridge, 1937) although I have had one report of their calls being heard in LaFlore county just north of this in the Ouachita mountains. In southern McCurtain county they seem to be fairly common, for nearly everyone from the University of Oklahoma who has looked for them on recent trips to this region has brought them in. Their abundance in southeastern Oklahome in the Red River Valley makes it almost certain that they also occur across the river in Texas.

Their breeding season is apparently early in the spring here as elsewhere, because on trips in May and June to this region during and after rains when many other forms were calling, both Dr. Charles C. Smith and I have consistently failed to see them in breeding congresses.

Hyla cinerea cinerea (Schneider) (Green Tree Toad)

This is a form of southeastern distribution which ranges westward to north central Texas (Wright and Wright, 1938). It enters Oklahome only in the extreme southeastern corner, the only record being that of Trowbridge (1937). I, personally, have never collected it within the state.

Acris crepitans Baird (Northern Cricket Frog)[4]

Acris crepitans has recently been separated from *A. gryllus* by Dunn (1938) on the basis of the extensiveness of webbing of the hind feet and upon other characters. Dunn also restricts the latter to the

4 **Acris gryllus** (LeConte) is known as the cricket frog because of its type of call. "Northern Cricket Frog," therefore, would seem to be an appropriate vernacular name for its northern relative whose call is also cricket-like.

southern coastal plain. All of the hundreds of specimens from Oklahoma which I have examined seem clearly to be *crepitans* in Dunn's key and also compare with specimens which I have collected in Wisconsin. Therefore, I conclude that all of the numerous records of cricket frogs in Oklahoma are *crepitans* and that *A. gryllus* does not occur in the state.

Interpreted in this manner, *A. crepitans* is statewide in distribution with the possible exception of the two western counties in the panhandle. In Kansas, Smith (1934) also found a cricket frog, called by him *Acris gryllus* (Le Conte), to be statewide. This undoubtedly is the same as *A. crepitans* of Oklahoma. The account of habits, habitat, and coloration as given by Smith are practically duplicated by my own observations in Oklahoma. Wright and Wright (1933) could not separate these two species with certainty but the same authors later (1938) mention only *Acris gryllus crepitans* Baird from Texas and declare it to be present from, "Sabine River to trans-Pecos; panhandle to southern Texas." More recently (1942) they have accepted Dunn's interpretation. Some of the southern or southeastern specimens in Texas may be *A. gryllus* but it is practically certain that the western and northern form in this state is the same as that of Oklahoma and Kansas, that is, *A. crepitans* Baird as separated by Dunn. I have collected typical *A. crepitans* in Somervell and Montague counties, Texas.

So many localities in Oklahoma are represented by specimens that it is simpler to list the counties where it has not specifically been taken or heard. These are Craig, Grant, McIntosh, Okfuskee, Johnston, Kingfisher, Dewey, Ellis, Texas, and Cimarron counties. It has been previously reported in forty-three Oklahoma counties, leaving twenty-four as new county records reported here. Of these, five (Cotton, Jefferson, Marshall, Blaine, and Noble) are based upon calls alone, the others on specimens collected personally or given me by others.

In a previous paper (Bragg, 1940) I reported that this frog had not been heard calling about buffalo wallows and apparently did not use these for breeding. I have since heard them twice in such places but neither time were tadpoles produced. I still doubt if they ever breed in buffalo wallows, athough they feed about these pasture pools in some numbers, particularly in late spring.

Another detail of their habits is of interest. This is their marked tendency to wander at night between one creek or pool and another.

I have often found them in roadways during such movements. These movements occur at all seasons (except winter) to some extent but are most marked during two conditions: (1) in spring and early summer after rains and (2) in midsummer drought when pools and creeks are disappearing because of evaporation.

These little animals are quite frog-like in habits and habitat. They can be found active almost anywhere in Oklahoma where there is standing water, even in winter (except in severe weather). Every river, lake, creek, or cattle tank has its quota about its margin and their calls may be heard night and day from such areas. Most breeding is in midspring but may occur as late as September (Bragg and Smith, 1942). They are very agile but not particularly shy and are easily caught by hand if one takes advantage of their apparent dislike of deep water. If greatly frightened they may hide on the bottom after the manner of the commoner ranas. Usually, however, they jump to the water, swim rapidly back to the bank at another point, and depend upon their agility here to escape danger. Many of them fall prey to the larger frogs of their habitat and to shore-feeding birds such as herons. Presumably many are eaten by water-snakes also, but I have seen no specific instances of this. They feed on all sorts of insects present in their habitat and are surprisingly accurate in catching them by long quick jumps. I have seen one catch a damsel fly with one jump of about four feet.

Pseudacris streckeri Wright and Wright
(Texas Ornate Chorus Frog)

Since the life history and distribution in Oklahoma of this species has recently been given in detail (Bragg, 1942c) little need be added here. It is now known to be present in twenty-one Oklahoma counties from near the Kansas border to Texas. It is the earliest form to breed in Oklahoma (Bragg and Smith, 1942) and the earliest (except *H. c. crucifer*) to cease breeding activities. It feeds in pastures and along road sides at night during the warmer portions of the year, most often seen in these situations after rain. It has been taken from roadways after rains off and on from March to October. Since writing on its life history, I have made further observations which are of special interest.

In the earlier paper (Bragg, 1942c) it was pointed out that eggs are difficult to find during some years but quite abundant during others, although males may call lustily. In the spring of 1942, males were

calling from February to early May but no females were seen till after a very heavy rain (5.1 in.) at a near freezing temperature in early March. Notes taken that night in the field read, "*Ps. streckeri* females may be stimulated to seek males more vigorously by rain. The males have been calling for a long time and some eggs have been laid; however, tonight, a very large number of eggs are being produced and more females than I have ever before found at one time are in or near the pools." I saw several other such instances during April and could find no evidence against the conception expressed above.

These observations apparently explain why both Prof. G. A. Moore and I have had the impression that more breeding occurs during years of much winter rain.

Pseudacris clarkii (Baird) and **Pseudacris triseriata** (Wied) (Spotted Chorus Frog and Striped Chorus Frog)

The taxonomic relations of these two forms have been in confusion for a long time. Most eastern herpetologists relegate both forms to *Ps. nigrita* as subspecies. Some (e.g. Burt, 1932) consider *triseriata* to be specifically distinct from *nigrita* with *clarkii* as a subspecies of it. Wright and Wright (1933, 1938, 1942) recognize both forms as subspecies of *nigrita* and Stejneger and Barbour (1939) retain this arrangement without comment, thereby tacitly discounting the evidence of Smith (1934) that the forms are specifically distinct. In a recent communication to the author, a well-known American taxonomic hereptologist stated, "I can understand *clarkii* only as a subspecies of *nigrita* or *triseriata* and I suspect that in Oklahoma you have a single but variable form." On the other hand, another prominent worker, with much experience with this group, declared in a letter, "I know *triseriata* to be quite variable but I am certain that it is specifically distinct from either *clarkii* or *nigrita*." Under such circumstances, one can only present his evidence, draw his conclusions, and then hope that he has contributed something toward a solution of the difficulty rather than adding to it. Therefore, I shall write the remainder of this account of these two forms from my observations alone, taking no notice of the *opinions* of others; although, of course, I shall use their *observations* as published.

I begin by stating my general conclusions and follow this with the evidence for it. The two forms are specifically distinct and their adults can always be separated on the morphological characters given

by Smith (1934). My evidence (in addition to that given by Smith) that this is so can be summarized as follows:

(1) They occupy different habitats in Oklahoma. *Ps. triseriata* is primarily a form of the woodlands and lower, moister areas; *Ps. clarkii* is restricted to the prairies and to prairie islands in savannah. The former is very abundant all over the western half of Oklahoma and does not occur in the southeast at all. On a night after heavy rain in June, 1940, I traveled from central McCurtain county in the southeast to central Cleveland county in the central part of the State. Thousands of *Ps. triseriata* were calling (and several collected) everywhere till central Pontotoc county was reached. Then ,suddenly, they became rare and within five miles had disappeared altogether. Simultaneously, calls of *Ps. clarkii* began to be heard, at first in the same pools with *triseriata,* but soon alone. From here on *clarkii* were calling from almost every ditch and puddle till daylight showed and finally stopped the chorus in McClain county. Similarly, in southwestern Oklahoma on several good breeding nights, I have never failed to hear and collect *clarkii* alone. In eastern Oklahoma, the same is true of *triseriata.*

(2) Their calls are different. I have heard both hundreds of times, sometimes together, but more often separately, and I have taken pains to see if I could tell the difference. Whenever I have had opportunity, I have identified the call before stalking the animal and, since my early experiences, have never failed to be correct. In one case, only one of each was calling in a pool. They were both together and I decided which was which before catching both simultaneously, one in each hand. Again, I was right.

(3) Their eggs and egg laying differ. With *Ps. triseriata* (Wells, 1924)[5] eggs are laid on slanting vegetation (twigs in this instance) and in considerable numbers to a mass. Smith (1934) indicates masses of from 110-300 eggs, the mode about 140, but he quotes others who found less than this (see also Wright and Wright, 1933, 1942). With *clarkii,* the eggs which I have seen (hundreds of masses) have all been on *upright* vegetation and in small masses often as few as six, seldom more than twenty, usually on sedges or grasses, almost never on twigs.

The individual eggs of *triseriata* are brown, or black, and white (Wright and Wright, 1933) ; those of *clarkii* always brownish-gray, shading to white at the vegetal pole. The egg-complement of *triseriata*

5 Presumably this species if taken at Chicago, as implied.

is 500-800 (Wright and Wright, 1933). That of *Ps. clarkii* in one case was 916 by my individual count and dissection of several females showed the ovaries with large numbers of eggs indicating that the usual number is large. Measurements of individual eggs of *clarkii* indicate a mean diameter of 1.04 mm. with a mode of 0.959 but with variation so great as to be noticeable with the naked eye. This egg size is comparable to that of *Ps. triseriata* but the variation in *clarkii* appears to be greater.

(6) Their tadpoles differ in many details. That of *triseriata* apparently is somewhat variable in different areas (unless other tadpoles have been confused or unless the species has unrecognized subspecies of which there is some evidence; see beyond). Wright and Wright (1933) indicate a small (23 mm.), dark, bronzy tadpole, full-bodied, with a long-tipped tail, and with tooth ridges 2/2. Youngstrom and Smith (1936) give evidence of a 30-32 mm. grayish tadpole, tail tip obtusely rounded but somewhat attenuated at the end, and a labial formula of 2/3.

The tadpole of *Ps. clarkii* has not been studied in detail (see, however, summary by Wright and Wright, 1942). I have studied it during two seasons now, both from pairs taken from congresses and reared in the laboratory, and in the field. All stages have been studied from egg-laying to metamorphosis. Details will be given later in a separate paper. This tadpole differs from *triseriata* as follows: (1) lighter in color; (2) larger at hatching (3.9-4.7 mm. as compared to 2.5-3.0); (3) motile at hatching instead of premotile (Youngstrom and Smith); (4) details of color pattern; (5) details of mouth parts; and (6) behavior and appearance at and after metamorphosis (I have seen both species of these and collected and watched them about native pools); young of *clarkii* remain about pools for some weeks, those of *triseriata* leave within a few days; young *clarkii* are agile and difficult to catch by hand, *triseriata* much less so; young of *clarkii* begin to be spotted, including the large conspicuous triangular spot back of the eyes emphasized by Smith (1934), before the tail is completely gone; *triseriata* become striped at about the same stage (Youngstrom and Smith, 1936, fig. 7), but this varies among individuals, some not showing the characteristic dorsal markings till a few days later; *clarkii* is very long and slim bodied when just out of the pool; *triseriata* is more heavily built, more round-nosed, and appears heavier and more bulky. (This correlates nicely with the difference in agility noted above.)

(7) I find little evidence recorded tending to show intergradation

of taxonomic characters indicative of subspecific identity of *triseriata* with *nigrita*.[6] Their ranges meet in the middle south and intergradation may later be shown to occur there. In the case of *clarkii*, intergradation with *nigrita* is clearly an impossibility; for, the former's range does not come anywhere near that of the latter. If the criterion of subspecies be primarily the presence of intergradation of characters along the zone where the ranges of two forms meet (the usual concept) it is obvious that *clarkii* can not be a subspecies of *nigrita*. The relation between *clarkii* and *triseriata* is not so clear-cut, however. As already indicated, the former is the prairie form in Oklahoma; the latter, primarily the woodland and savannah form. *Triseriata*, however, is not limited to its characteristic habitat, for I have seen it rarely in the tall grass prairie of northeastern Oklahoma, in the shortgrass plains of the Texas panhandle, and in the valley of the Gallinas Creek at Las Vegas, New Mexico (also in short-grass country), and very rarely in mixed-grass prairie at Norman, Oklahoma (Bragg, 1942b). Burt (1936) says that intergradation occurs in southern Kansas and perhaps in eastern Texas, which is contrary to the opinion of Smith (1934). If intergradation were to occur both in southern Kansas and eastern Texas, one would certainly expect it in east central Oklahoma in a marked zone, running approximately north and south through the state. I find no such zone, even though I have collected all over the area where it should occur. As explained earlier, animals taken form breeding congresses (whether when only one or both are present in the same pool) are always clearly the one or the other, both in morphological characters and in call. *Ps. clarkii* sometimes tends to be striped rather than spotted; *triseriata* spotted rather than striped. This is not evidence for intergradation along a zone where ranges meet because I have taken many spotted *triseriata* east of the range of *clarkii* in Oklahoma (e.g. in eastern McCurtain county, near the Arkansas line) as well as far west of the range of *clarkii* (one at Las Vegas, N. M.). Similarly, striped *clarkii* are no more abundant in east central Oklahoma than farther west in the state. About Norman, just west of the area where the *triseriata* abundance stops, both spotted and striped *clarkii* are present, the spotted ones the more numerous. There is no difference in the calls of these two variants.

The situation seems to be, therefore, one in which a very wide

6 It should be noted, however, that this is the weakest point in my argument for I have never studied **Ps. nigrita** alive nor seen it breed. I also suspect that I may have missed some of the literature.

ranging, variable species *(triseriata)* has its range crossed by that of a related, but distinctly less variable species *(clarkii)*, the first species being present only locally, and seldom in abundance within the range of the second, which, therefore, largely but not completely, replaces the first. This situation is clearly correlated with the ecological divisions of the area in question, *clarkii* being the abundant form in the mixed-grass and eastern portions of the short-grass prairies, whereas *triseriata* is the form of the woodland-savannah to the east and north and the short-grass plains (in local situations) to the west. The species meet and overlap slightly in the tall-grass prairie of Kansas, Oklahoma, and possibly Texas; and also (with less overlap) in the open savannahs of southeast central Oklahoma.

Ps. triseriata (as here interpreted) has formerly been reported from five Oklahoma counties (McCurtain, LeFlore, Lincoln, Tulsa, and Cleveland). I now have specimens from Choctaw, Latimer, Atoka, Seminole, Washington, and Mayes, and have recognized the call in Pushmataha, Coal, Pontotoc, Oklahoma, Rogers, and Seminole counties in addition. It is, therefore, now known from sixteen counties, all in the eastern half of Oklahoma.

Ps. clarkii has been previously reported in from thirteen counties. Additional records based on specimens seen are Washington, Garfield, Noble, Logan, Blaine, Greer, Jefferson, Love, Marshall, Johnston, Murray, Garvin, and Seminole counties, with call records in Kingfisher county in addition. This makes a total of twenty-six counties in which *Ps. clarkii* is now known to occur, all in the western two-thirds except in the Osage prairies (tall grass) of the northeast.

Variations in *Ps. triseriata,* while not particularly toward *clarkii,* are nevertheless marked. In southeastern, eastern, and central Oklahoma the coloration is darker than in the northern part of the state where they more closely resemble the specimens which I have seen from Kansas.[7] Then, there is a peculiar variation in call. Dr. Charles C. Smith collected specimens of *Ps. triseriata* at Monroe, Louisiana which he turned over to me for study. In his notes he says the call appeared higher in pitch than that of *triseriata* which we had heard together in Seminole county, Oklahoma. Later, he demonstrated this to me in southeastern Oklahoma.

In McCurtain, Choctaw, and Atoka counties, most of the calls were of a high pitch; some lower. As we came northwestward, calls of both types came from the same pools and ditches more frequently

7 Through the courtesy of Dr. Edw. H. Taylor of the University of Kansas.

till the higher call began to drop out in southeastern Pontotoc county (only a few miles east, incidentally, of where the westernmost *clarkii* were heard). All specimens west of this area had the hoarser calls, like those heard earlier by us together in Seminole and Oklahoma counties and by me in Cleveland county. Specimens calling in each manner from the same pool were stalked and captured but I could find no consistent morphological differences between them. Dr. Smith was certain that the higher pitched call was identical with those heard by him in Louisiana. We were agreed that the lower pitched one was identical with that heard by us together in several other places in Oklahoma and which I identified as the same as that heard by me at Las Vegas, N. M. It is interesting to note that tadpoles produced from eggs laid by the specimens in Louisiana and given me by Dr. Smith conformed very closely to the characters given for this larva by Wright and Wright (1933) except that the labial formula was 2/3 instead of 2/2. This was a much darker tadpole than that of the Kansas form studied by Youngstrom and Smith (1936); in fact, it was almost black; and, after metamorphosis, the young were very much darker than those which I have seen emerging from pools in central Oklahoma. These facts suggest that at least two (maybe more) races, ecads, varieties, or subspecies of *Ps. triseriata* may occur which are at present unrecognized. Only further study of life histories from known parents in the critical areas will clear up the matter.

Microhyla olivacea (Hallowell) (Texas Narrow Mouth Toad)

Microhyla olivacea[8] occurs from northern Mexico north through Kansas, east to western Arkansas and Missouri (Smith, 1934; Anderson, 1942). No one seems to know how far westward its range extends. In Oklahoma it is statewide and abundant except, possibly, in western part of the panhandle. I have collected in many parts of the state and have found no other species of the genus here. Therefore, I conclude that the several Oklahoma records of *M. carolinensis* were all based upon this species. Including these, *M. olivacea* has previously been reported from twenty-one Oklahoma counties. My new records are based on specimens from Kay, Tulsa, Latimer, Choctaw, Atoka, Pittsburg, Hughes, Coal, Pontotoc, Murray, Carter, Love, and McClain counties. Dr. Chas. C. Smith has seen it also in Harper county which is the only record in the northwestern part of the state.

8 Still called **Gastrophryne olivacea** by those who emphasize the distinctiveness of the American genera from those of the Old World. See Steineger and Barbour (1939). Wright and Wright (1933) use Gastrophyne, later (1938) they use Microhyla but now (1942) return to Gastrophyne.

Thus, *M. olivacea* is known to occur in approximately half (35 out of 77) of the Oklahoma counties with little if any ecological restriction in habitat. It is, however, rarely if ever found on extensive flood plains of rivers.

Its habits in Oklahoma are essentially as described by Smith (1934) in Kansas and need not be reviewed specifically here. (See also earlier notes in papers by the author and his associates.) I should like to emphasize a few observations on its breeding, however, which either have not been sufficiently stressed or not published earlier.

(1) It exhibits the xeric breeding pattern characteristic of prairie-limited species in Oklahoma (see Bragg, 1942e for details of this pattern.) It breeds only after rain when the air temperature is relatively high; and it will breed after any rain sufficient to fill temporary pools from late April to September. Therefore, it has no breeding season (except in so far as the whole late-spring-to-early-fall period may be considered one).

(2) Males often call close together in grass clumps. I have seen them many times in twos, threes, and fours, in single clumps of protruding vegetation when there was no apparent environmental reason for it. So close do they approach each other that I have several times caught two with one plunge of the hand, despite the fact that this is one of the most difficult frogs known to me to catch (or to hold after one has caught it). This suggests strongly that the males are attracted by each other's calls, a factor characteristic of the xeric breeding pattern.

(3) The males commonly call from shallow water either near the edge or all over the pool; but mated pairs and (later) eggs are almost always seen near the bank. Females approach males whenever they are calling in the pool and mating probably takes place at the male's calling station. It follows that the newly mated pairs, if not already near the bank, swim to this for egg laying. I have seen females approach calling males on several occasions but never have succeeded in actually seeing a natural mating.

(4) The call of this species varies more than commonly supposed. Most individuals give a slight and very short "peep" followed by a high pitched buzz (Wright and Wright, 1933). Some open without the peep and have a deeper buzz. In general, it is the larger males which have the deeper voices but some with deeper voices open with the peep and some with shriller voices do not. So far as I can tell, these are individual variations, for I have never heard an individual change its note.

SUMMARY

The family Hylidae is represented in Oklahoma by three genera, Hyla, Acris, and Pseudacris. The first includes *Hyla v. versicolor*, *H. c. crucifer*, and *H. cinerea cinerea*; the second, *A. crepitans*; the third, *Ps. streckeri*, *Ps. triseriata* and *Ps. clarkii*. The family Microhylidae is represented by only one species, *Microhyla olivacea*.

Most of these are distributed in accordance with major ecological divisions of the state. *H. v. versicolor* occupies the eastern half (in woodland and savannah) but follows the flood plains forests of the larger rivers westward in the southern part of Oklahoma. *H. c. crucifer* and *H. c. cinerea* are known only in the low, swampy areas of the Red River Valley in southeastern Oklahoma. *Ps. strickeri* is known in a broad zone running north and south through Oklahoma from near Kansas to Texas. It is abundant in the mixed grass prairie and oak-hickory woodland-savannah of this zone but has not been found in either tall or short grass prairies to the southeast and west respectively. It is very abundant on flood plains of the larger rivers within the zone designated. *Ps. clarkii* is the species of the prairies, *Ps. triseriata* the species of the woodland-savannah of Oklahoma. The former, therefore, is restricted to the western half of the state except in the northeast where its greatest eastern extension occurs in the western edge of the tall-grass prairie. *Ps. triseriata* is abundant in the eastern third of Oklahoma, especially in the southeast, but it inhabits small suitable areas west to the Rockies. It has, however, not been specifically taken in western Oklahoma. Reasons are given for recognizing these two forms as specifically distinct. *Microhyla olivacea* is probably statewide in distribution, although unknown in the Oklahoma panhandle. While ecologically unrestricted, it exhibits a xeric type of breeding pattern characteristic of the prairie-limited species.

Specific county records of all of these species and notes on the habits of several of them are given in the text.

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NOTES ON THE LIFE HISTORY OF EUMECES SKILTONIANUS SKILTONIANUS[1]

WILMER W. TANNER
In charge of Biological Sciences
Provo High School

One of the most interesting lizards in Utah is our representative of the sincoids, *Eumeces skiltonianus skiltonianus* (B. & G.). This attractive lizard, with its bright blue tail and the four light body stripes across its dark body, attracts the attention of laymen as well as students. The color pattern is very striking in the young and the adult males. The females are less colorful. I have examined females with but little blue in their tails, and only faint body markings. This drab color seems to persist during the entire year and is not in any way related to the mating or egg laying period. In my experience during the past summer, the sexes can be readily distinguished by the intensity of the blue color. The brilliant blue tail of the males was always the most noticeable body part. I am in agreement with a study[2] made recently, suggesting that the tail factor has survival value for this genus.

The following notes on the life history of Skilton's Skink are based on specimens collected and nests observed during the summer of 1939, while the writer was collecting in northwestern Utah county. These specimens are now in the Brigham Young University Herpetological collection.

Other specimens were collected during the early summer of 1941 and 1942. Those taken in the latter year were placed in three cages. Two cages contained two females and one male each; the third cage contained one pair. Each cage was provided with a thick layer of loose soil mixed with rocks. Two cages were placed under trees in order to provide conditions as near that of the collecting area as possible. The third was kept in the laboratory. In spite of careful feeding and observation no mating activities were observed in either, nor were there any eggs laid.

Other specimens in the collection, collected from various parts of the state, Washington, San Juan, Beaver, Millard, San Pete, Summitt,

1 Contribution No. 107, Department of Zoology and Entomology, Brigham Young University.
2 Jopson, Harry G. M. 1938. Observation on the survival value of the character of the blue tail in Eumeces. Copeia, June 30, 1938, No. 2, pp. 90.

and Utah Counties, indicated that this species is quite widely distributed over the entire state of Utah.

DESCRIPTION OF THE NESTS

Five nests of these lizards were found and placed under observation and study for two weeks, August 2 to August 15 in 1939. The nests were all located on the south side of a small rocky point. The rocks were not excessive in size and were partly shaded by sage, *Artemisia tridentata,* oak, *Quercus gambellii* and with a few Utah junipers, *Juniperus utahensis* scattered through the sage. Only two (2) nests were associated with rocks which were shaded. The others were in the open.

My discovery of these underground dwellings came as a great surprise, while turning rocks in search for snakes. My interest was intensified when I found that only a little had been written about the nesting habits of this species. The only reference in the literature referring to the reproduction of this lizard, I have been able to find, is one by Dr. John Van Denburgh.[3] Dr. Van Denburgh states: "Mr. Edmund Heller secured the eggs of this lizard at Pacific Grove, California. The five eggs were spherical and of a blackish brown color, with soft flexible shells. They were about the size of a Chipping Sparrow's egg (Spizellasocialis occidentalis). He found them in an open field, among a rock pile, under a flat rock. They were covered with about half an inch of loose earth. The female was found under the rock with them. The date was about June 15, 1898. The eggs were far advanced in incubation, the embryos presenting nearly all the adult characteristic markings, coloration, etc."

Dr. Edward H. Taylor in his extensive report on the genus Eumeces[4] makes but little reference to the habits of Skilton's Skink; his report deals entirely with the taxonomy and distribution of the species. In this respect it is most complete; in this report I am dealing only with life history notes.

The following notes are presented in the belief that they may be of interest, and a contribution to the present information of our western reptile fauna.

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3 Van Denburgh, John, 1922. Reptiles of the Western United States. Occasional Papers of the California Academy of Sciences. Vol. 1, Lizards, pp. 84.

4 Taylor, Edward H., 1935. A Taxanomic Study of the Cosmopolitan Scincoid Lizards of the Genus Eumeces. Bull. Univ. of Kan., Vol. 36, No. 14, pp 410-428.

Nest Number One

The first nest was found 9½ inches below the surface of the ground and 3½ inches in the soil from the uphill side of the rock. The small hole leading to the nest was one inch in diameter, while the nest had been rounded out and was 2½ inches wide. The floor of the nest was covered with loose moist soil. No leaves on debris was present. This nest contained four newly incubated lizards and the adult female. The entire family was collected and preserved. The measurements were taken soon after the lizards were killed. (August 3)

Nest Number Two

The second nest was found soon after the first. It was eight inches below the surface of the ground and three inches in the soil from the uphill side of the rock. The hole leading into the nest was ⅝ of an inch wide and 1½ inches high. The nest itself was nearly three inches wide. The nest contained four (4) eggs. They were white and very uniform in size. The eggs measured 15–16 mm. long and 9–10 mm. wide. One side of each egg was slightly distended. The eggs were in the center of the nest, and were not in any sense covered with soil. The soil below them was moist and loose. When the rock was moved the eggs were noticed at once. Before I could examine them, the female came from the back of the nest, saw me, and deserted her nest. She was captured and one toe on the right hind foot was clipped off for identification. The female was returned to her nest, and the eggs left for observation and incubation. (August 3)

Nest Number Three

The third nest was found under one of the largest rocks on the hillside. The outside entrance apparently did not go under this rock, but along the side. The entrance tunnel was about 15 inches long. The nest was located in the soil about 2½ inches above the bottom of the rock and eight (8) inches below the surface. This was the largest nest found; it measured 3½ inches wide and 1½ inches high. The nest contained four (4) newly hatched lizards and the female lizard. Soon after the rock was moved the female lizard deserted her nest. No effort was made to capture her, instead rocks were placed around the entrance leading to the eggs; this was done to protect the nest from the loosened soil. I then remained a few feet away to observe.

After ten minutes I observed her in the oak and sage leaves at the

edge of the hole by the rock. For several minutes she explored the hole thoroughly, as well as the rock pile which protected her eggs, passing the entrance to the eggs several times. Finally, very cautiously she entered the nest and remained. (August 3)

Nest Number Four

Nest number four was found at the edge of a large flattened rock, which was under a sage brush. Upon moving the rock the nest was clearly visible. It contained four (4) eggs. The eggs were in a nest about 3 inches wide and about 1½ inches high. The entrance to the nest was level with the base of the rock. The nest was not disturbed further that day. (August 3)

Nest Number Five

The next morning I found the fifth nest. Of all the nests this one was most difficult to locate. The tunnel was located under a small rock and between two other rocks. These were moved and the tunnel was found under still another rock, at the back of which two (2) eggs and the female guardian were found. The nest was ten inches below the surface. It was small, being only 2 inches wide and 1 inch high. No attempt was made to capture the female at this time.

The nests were all found within a short distance of each other. The extreme distance being 200 feet. It is interesting to find that a female was found in each of the five nests.

THE EGGS AND YOUNG LIZARDS

In this study ten eggs and eight young lizards were observed. The eggs were uniformly white in color and all were uniform in size (15–16 mm. long and 9–10 mm. wide). From a short distance away they appeared as sparrow eggs. At the time of discovery none of the eggs were covered, not even in part, but were lying on the floor of the nest not more than a fourth of an inch apart. The day after my discovery of nest number two (2) an egg was removed from it in order to observe the extent of incubation. The young embryo was well formed and measured 57 mm. The other eggs from this nest hatched August 14, eleven days after they were discovered. The largest specimen measured 69 mm.

In locating nest number five (5) one of the eggs was injured. This egg was opened and studied. The embryo in it was alive and measured 62 mm., total length, and 34 mm., tail length. The second egg hatched four days later, August 8, and measured 66 mm. in length. From my study of the embryos from nests two and five it appears

that for the last few weeks the embryo develops at the rate of about one mm. per day. The other eggs were observed while hatching, and in each nest (2 and 4) the eggs all hatched within a few hours of each other. Example: Nest four was observed at 2:30 p. m., August 13. One egg was hatching. At 10 p. m. all eggs had completed their hatching.

The young lizards taken from nest one (1) had, from all appearances, just completed hatching a few hours before they were collected. Their measurements were almost identical with those hatched later. Nest three (3) was left for observation. No measurements were taken since they appeared identical with those in nest one (1). After observing this nest for several days the "family" suddenly disappeared. I searched relentlessly in the hope of finding them under a nearby rock. After working a radius of 43 feet from the nest a small garter snake *Thamnophis o. vagrans* B. & G. was collected. After examining it, it was found to have just eaten a meal of four (4) young lizards, two of which had not been digested. They were 4 to 5 mm. longer than the average newly incubated lizard. Whether they were from another nest or from the one under observation is not known. It is my opinion they represent a new family.

During my spring collecting, a young skink was collected about three miles from the nesting area described above. This lizard was collected May 15, 1939 and measured 90 mm. long. In appearance this lizard is the same as those observed in August. From my findings it appears that *Eumeces s. skiltanianus* in Utah "nests," mostly if not entirely, from the first of July until late August.

INTERESTING HABITS

During the study of this species only rarely were specimens observed out feeding or moving from one place to another. Most specimens observed were seen only after they had been molested by turning rocks. On one occasion two specimens were observed in a small opening among the oak brush. Upon approaching too close, both hurried into the loose dry oak leaves. As they moved across the opening their blue tails were vigorously wiggled, as if to attract one's attention. This tail wiggling was observed in all specimens, even the young lizards exhibited it.

One morning while observing in the nesting area, one of the females was seen a short distance from her nest. Her movements through the leaves and rocks were slow and with a jerky motion. Her

ability to creep over and through the dry leaves without making a noise was amazing. The fact that these forms are very secretive in their habits explains in part why more were not seen. Their movements and habitats must also be regarded as an important factor.

The most interesting habits observed were those associated with the "nesting" females. As stated above, all nests were cared for by a guardian; this term has been applied to the female since in every instance she was present at the nest. In some cases the area around the nests was completely changed due to the turning of the rocks. In spite of these changes the guardian was undaunted in her efforts to remain with the eggs or the young. For a few days it appeared as though nest No. 2 had been deserted, but after 6 days she was again on duty. Of the five (5) nests observed only one lizard made any attempt to remain with the nest while it was being uncovered and investigated. This lizard, in nest 4, was a real guardian. Each day she appeared in front of her eggs and attacked any object thrust into the entrance. On August 4, with the aid of a small stick, an attempt was made to remove one of the eggs for examination. No sooner had the egg been touched than she attacked the stick, biting it and holidng on tenatiously. In removing the stick she was pulled with it to the mouth of the entrance. Here she released her hold and returned to the nest. A second attempt resulted in the same activities. No other lizard showed so much concern about her nest. Each day as the nest was visited she would engage in the same defense of her eggs.

On August 10, the eggs from nest 2 and 4 were collected. In collecting them a small stick was used to roll the eggs out of the hole. As before the stick was attacked several times by the female in nest 4 before the eggs could be rolled toward the entrance of the nest. In nest 4, while the first egg was being rolled, the guardian followed close behind. As it neared the entrance, she seized the egg, after biting it several times she released it. In this encounter the egg had been ruptured slightly. The female lizard made no attempt to escape, but remained with the egg until she was collected.

In locating the nests a certain amount of disturbance of the soil at the nest entrance was unavoidable; this resulted in the guardian moving the eggs in and extending the nests. In nests Nos. 4 and 5 the females nearly filled up the entrance to the nests with soil and moved the eggs several inches farther in from the entrance.

It was interesting to note the large number of males uncovered in the nesting area. Most of them were found under rocks, but several

were found at the end of small tunnels leading 10 to 15 inches under ground. From my observations it appears that the males have underground tunnels much the same as those of the females but without an enlarged nest.

FEEDING HABITS

A number of writers have referred to this species as an insect feeder (3) (4). Dr. Woodbury[5] observed them "feeding on flies." During this study at no time was it my good fortune to observe them feeding. An attempt to observe feeding was made while they were in captivity but without success; although it is certain that feeding did occur because the insects, grasshoppers, flies, etc., disappeared. A study of the stomach contents of six specimens reveals, at least in part, the types of invertebrates preyed upon by these lizards. Much of the food was of those forms commonly found under rocks and leaves (moths, beetles, crickets, and grasshopper remains were observed in the stomach contents). This may explain why open feeding was not observed in the nesting area.

An attempt to further study the life history of these lizards has failed to produce any information pertaining to the date of egg laying, mating or other desirable data. The study will continue in the hope that a more complete story may be told at a later date.

In order to provide a basis for comparing juvenile and adult specimens, a table of measurements and scale counts is included of those taken in the nesting area.

SUMMARY

1. In this paper the life history of Skilton's Skink, *Eumeces s. skiltonianus* (B. & G.) is discussed.

2. The lizards were found to have under ground "nests," in which the eggs were laid and protected by the females, until the young lizards were hatched, and were able to care for themselves.

3. The female lizard did not readily desert her nest.

4. The food habits were apparently quite secretive. The food consisted of insects.

5. A table of measurements reveals the size of these forms at the time of hatching and at adulthood.

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5 Woodbury Angus M., 1931. A Descriptive Catalog of the Reptiles of Utah. Bull. Univ. of Utah, Vol. 21, No. 5, pp. 59-61.

TABLE OF MEASUREMENTS

B. Y. U. Museum No.	Nest No.	Sex	Total Length	Tail Length	Snout to Anus	Dorsals	Ventrals	Scale Rows
2217	1		70	42	28	59	63	25
2218	1		70	42	28	57	65	24
2219	1		69	41	28	57	64	24
2220	1		68	40	28	57	65	24
2222	2		57	33	24	61	66	25
2229	2		69	41	28	60	64	24
2230	2		67	39.5	27.5	58	65	25
2226	3	♀	76	46	30	60	62	26
2227	3		75	45.5	29.5	60	66	25
2223	5		61	34	27	55	66	25
2224	5		66	39	27	60	66	24
2292	4		68	40	28	58	64	26
2293	4	♀	69	41	28	56	66	25
2099			90	55	35	56	62	24
2849	1	♀	138	78	60	59	66	26
2850		♀	162	103	59	58	67	25
2239		♂	140	98	52	59	67	25
2225	5	♀	117	54	63	60	66	24
2221	2	♀	125	64	61	58	66	24
2228	4	♀	125	60	64	61	66	26
2238		♀	113	50	63	60	64	24
2237		♂	135	74	61	56	64	24
2233		♀	131	70	61	60	67	24
2232		♀	131	67	64	61	67	25
2236		♂	123	69	54	55	67	24
2235		♂	144	89	55	58	65	24
2234		♂	129	78	51	58	65	24
2231		♂	147	89	58	57	67	25

UNDESCRIBED SPECIES OF WESTERN NEARCTIC TIPULIDAE (DIPTERA). I.

CHARLES P. ALEXANDER
Massachusetts State College
Amherst, Massachusetts

Following the recent publication of a manual considering the crane-flies of northeastern North America (The Diptera of Connecticut, Fascicle 1: 183-486, 501-509 (index); figs. 18-55, with 389 sub-figures; 1943), I am devoting all possible time to the preparation of a comparable work considering the fauna of the Rocky Mountain and Pacific Coast states and provinces, from the Mexican border northward through Alaska. The northeastern North American area includes about 500 species whereas the still insufficiently known western Nearctic fauna is already very much larger and will undoubtedy be found to exceed 1,000 species of these flies. In the present paper I am describing various species of the tribe Hexatomini from the western United States.

I wish to express my sincere thanks to Messrs. Thomas H. G. Aitken, George E. Bohart, Mont Cazier, Otto Degener, Anthony Downes, Merton C. Lane and James A. Macnab for their kindness in collecting ample materials in the Tipulidae and presenting such specimens to me. Still others of the specimens discussed at this time were taken by the late Dr. Harrison G. Dyar and Mr. Edward P. Van Duzee. Except where indicated to the contrary, the types of the new forms are preserved in my collection of World Tipulidae.

Limnophila (Prionolabis) sequoiarum Alexander, sp. n.

General coloration black, sparsely pruinose; antennae 16-segmented, black throughout; wings yellowish brown, with a conspicuous brown pattern, especially at origin of *Rs* and over the cord and outer end of cell *1st M*$_2$; *R*$_{2+3+4}$ short to very short; male hypopygium with the tergite produced into two conspicuous, microscopically roughened lobes that are separated by a very broad U-shaped notch; median area of ninth sternite produced into a fleshy median lobe; outer dististyle glabrous, provided with a single slender spine on mesal edge a short distance before the shorter apex; basal lobe of outer style very loosely attached, large and fleshy; inner dististyle a simple stout lobe; aedeagus not dilated or expanded.

Male.—Length about 9.5 - 10.5 mm.; wing 9.5 - 11 mm.; antenna about 1.8 - 2 mm.

Female.—Length about 11 mm.; wing 8 mm.

Rostrum and palpi black. Antennae 16-segmented, short, black throughout, the scape sparsely pruinose; basal flagellar segments oval, the outer ones more elongate; verticils of outer segments shorter than the segments. Head black, pruinose, the surface opaque.

Pronotum and mesonotum black, sparsely pruinose, the praescutum without distinct stripes. Pleura black, more heavily pruinose; dorsopleural membrane dark. Halteres obscure yellow. Legs with the coxae brown, gray pruinose; trochanters yellow; femora obscure yellow, the tips blackened, somewhat more broadly so on the fore pair where about the distal fifth is included; tibiae obscure yellow, the tips blackened; remainder of legs black; claws small, simple. Wings yellowish brown, patterned with darker brown; prearcular and costal fields more yellowish; conspicuous brown clouds at origin of *Rs,* cord, outer end of cell *1st M*2 and fork of M_{1+2}; stigma unusually small, dark brown; veins brown, brighter colored in the flavous fields. Venation: R_{2+3+4} short, variable in length, in cases subequal to basal section of R_5, in other specimens even shorter, the cell R_3 being very short-petiolate to subsessile; cell M_1 variable in length, from subequal to nearly twice its petiole; *m-cu* at or before midlength of lower face of cell *1st M*2.

Abdomen black, the surface nitidous or nearly so, the extreme caudal borders of the outer segments obscure yellow; hypopygium black, the ninth segment narrowly bordered with pale. Male hypopygium with the tergite large, the caudal margin provided with long blackened lobes that are separated by a very large U-shaped notch; lobes with microscopic appressed points or tubercles, the caudal border appearing crenulate. Ninth sternite similarly produced into a very conspicuous median lobe that is provided with abundant microscopic setulae and a very few long setae. Outer dististyle glabrous, compressed-flattened, widened outwardly, bearing a single very long slender spinous point on mesal edge a short distance before the shorter acute apex; basal lobe of style suboval, unusually separated from the style itself. Inner dististyle a simple stout lobe, at its base with an unusually small subglobular lobule. Aedeagus not dilated or expanded, as is the case in most other species of the subgenus. Gonapophyses simple, each with an acute spinous point that is directed cephalad.

Habitat.—California.

Holotype, ♂, Sequoia National Park, June 8, 1942 (Otto Degener).

Allotopotype, ♀, pinned with type. Paratopotypes, 10 ♂♂.

Limnophila (Prionolabis) sequoiarum is entirely different from all other described members of the subgenus. In all details of structure of the male hypopygium it is one of the most distinct species in our fauna. The undilated aedeagus is especially characteristic of this fly and suggests a parallelism with the related subgenus *Phylidorea* Bigot, where species are found with the aedeagus slender to others where it is broadly compressed-flattened, as is the common condition in the present subgenus.

Limnophila (Prionolabis) freeborni Alexander, sp. n.

General coloration black, the surface opaque by a sparse yellow pollen; antennae short, black throughout; knobs of halteres darkened; femora chiefly brownish black, the bases narrowly brightened; wings brownish yellow, rather heavily patterned with darker brown; male hypopygium with the outer dististyle having a single subapical denticle; inner dististyle with the outer portion a simple black rod, its base surrounded by several microscopically blackened spinulae; gonapophyses with apex obliquely truncated, the inner angle drawn out into a long pale point.

Male.—Length about 9 mm.; wing 9.5 mm.

Rostrum black, very sparsely pruinose; palpi black. Antennae very short, if bent backward extending only to the fore part of praescutum, black throughout; flagellar segments suboval, the more proximal ones crowded; longest verticils subequal in length to the segments. Head dull black, sparsely yellow pollinose.

Pronotum brownish gray. Mesonotum chiefly black, the surface opaque by a sparse yellow pollen, the praescutum without clearly delimited stripes; scutellum somewhat more heavily pruinose. Pleura grayish pruinose; dorsopleural membrane infuscated. Halteres with stem obscure yellow, knob infuscated. Legs with coxae black, sparsely pruinose; trochanters brownish yellow; femora brownish black, the bases rather restrictedly brightened, the fore femora more extensively darkened than the others; tibiae and basitarsi brown, the tips darker; remainder of tarsi brownish black. Wings with the ground color brownish yellow, rather heavily patterned with darker brown clouds; stigma dark brown; seams at origin of *Rs*, cord and outer end of cell *1st M*$_2$; vein *Cu* and axillary border less evidently bordered by darker;

veins brown, somewhat darker in the patterned portions. Venation: *Sc*2 in transverse alignment with the fork of *Rs*; *R*2+3+4 short, subequal to *R*1+2 or *R*2; cell *M*1 small, about one-half its petiole; *m-cu* at near midlength of lower face of cell *1st M*2.

Abdomen, including hypopygium, dull black, sparsely pruinose. Male hypopygium with the tergal notch U-shaped, the lateral lobes glabrous. Outer dististyle with only a single subapical denticle, this nearly as strong as the apical point; outer surface of style with microscopic appressed spiculae; outer basal lobe very inconspicuous, appressed to face of style. Inner dististyle with its outer portion a simple black rod, the base of which is surrounded by several microscopic black spinulae. Gonapophyses appearing as flattened yellow blades, paling to subhyaline at tips; apex obliquely truncated, the inner angle drawn out into a long pale point, the remainder of apical border with scattered irregular pale points. Aedeagus compressed-flattened.

Habitat.—California (El Dorado Co.).

Holotype, ♂, Echo Lake, near Lake Tahoe, altitude 7,500 feet, June 2, 1940 (T. H. G. Aitken). Taken at the cottage of Dr. Stanley B. Freeborn.

I am pleased to dedicate this interesting species to Colonel Freeborn, whose work on the mosquitoes of California has been outstanding. The fly is quite distinct from all other regional species, especially in the structure of the male hypopygium, notably of both dististyles and the gonapophyses, all of which have distinctive forms. In some regards the species is most similar to the species next described, *Limnophila (Prionolabis) vancouverensis*, but the resemblance is remote.

Limnophila (Prionolabis) vancouverensis Alexander, sp. n.

Size relatively large (wing over 10 mm.); general coloration black, gray pruinose, on the praescutum delimiting three more blackened stripes; fore and middle femora extensively blackened, the posterior pair somewhat less extensively so; wings brownish yellow, extensively patterned with brown, appearing as seams along the cord, outer end of cell *1st M*2, along vein *Cu*, and elsewhere; male hypopygium with the inner dististyle terminating in two points, with a mass of blackened appressed spinulae in the notch; gonapophyses expanded at tip into a narrow blade that is further produced into a short spinous point.

Male.—Length about 10 - 12 mm.; wing 10 - 14.5 mm.; antenna about 2.3 - 2.7 mm.

FEMALE.—Length about 14 mm.; wing 14 mm.

Rostrum black, sparsely pruinose; palpi black. Antennae 16-segmented, black throughout, scape a trifle pruinose; basal flagellar segments oval, the outer ones elongate and more slender; verticils relatively short and inconspicuous. Head dark gray; anterior vertex wide, about four times the diameter of the scape.

Pronotum heavily light gray pruinose. Mesonotal praescutum more yellowish gray pruinose, with three more blackened stripes, the median one slightly more pruinose than the laterals; pseudosutural foveae black, conspicuous; posterior sclerites of notum black, sparsely pruinose, the centers of the scutal lobes more polished. Pleura black, heavily pruinose; dorsopleural membrane dull buffy. Halteres uniform pale yellow. Legs with the coxae and trochanters black, sparsely pruinose, in cases the trochanters somewhat paler; fore and middle femora black with about the basal third yellow; tibiae and basitarsi black, the tips narrowly more blackened; remaining tarsi black; posterior femora somewhat more extensively pale, in cases with only the distal eighth or ninth blackened. Wings brownish yellow, the costal and prearcular fields clearer yellow, especially the latter; stigma oval, brown; an extensive, somewhat paler brown pattern, including the origin of *Rs*, cord, R_{2+3+4} and its fork, outer end of cell *1st M*$_2$ and a conspicuous seam along vein *Cu;* certain other veins more narrowly and less conspicuously seamed with brown, most evident on R_5 and *2nd A*; veins brown, yellow in the prearcular field. Venation: R_{2+3+4} variable in length, from subequal to the basal section of R_5 to fully three times this length; cell M_1 subequal to or a little longer than its petiole; *m-cu* close to midlength of lower face of cell *1st M*$_2$.

Abdomen, including hypopygium, dull black. Male hypopygium with the tergal lobes relatively small, the separating notch U-shaped. Outer dististyle with scattered teeth of various sizes, in cases these only two or three in number, in other specimens more numerous, up to five or six; outer fleshy lobe long, low and appressed, extending about to one-half or even to nearly two-thirds the length of style. Inner dististyle short and compact, the outer mass extended into a slender straight spine at the outer lateral angle, with a shorter and stouter lobe at the inner angle, the notch between these points with a conical mass of appressed blackened spinulose points; basal lobe of style small but conspicuous, with unusually long setae, the longest more than twice the length of the lobe. Gonapophyses slender-stemmed, at apex dilated into a compressed-flattened head, thence produced into a relatively short beak. Aedeagus compressed-flattened.

HABITAT.—Northwestern North America (Vancouveran Biotic Province).

HOLOTYPE, ♂, Boyer Station, near McMinnville, Yamhill Co., Oregon, July 5, 1936 (J. A. Macnab). ALLOTOPOTYPE, ♀, July 13, 1936 (Macnab). PARATOPOTYPES, 7 ♂ ♀, May 27 - June 21, 1934; June 11 - July 14, 1935. PARATYPES, ♂ ♀, Juneau, Alaska, June 22, 1919 (H. G. Dyar); Ketchikan, Alaska, June 20, 1919 (H. G. Dyar); Ashford, Pierce Co., Washington, June 7, 1921 (H. G. Dyar); Forks, Clallam Co., Washington, July 1, 1920 (E. P. Van Duzee); Lake Cushman, Mason Co., Washington, June 27, 1917 (H. G. Dyar); Silver Falls State Park, Marion Co., Oregon, June 23, 1939 (T. H. G. Aitken & G. E. Bohart); Elk Lake, Marion Co., Oregon, altitude 3,850 ft., July 3, 1938 (M. C. Lane); Prospect, Jackson Co., Oregon, May 22, 1921 (H. G. Dyar).

Limnophila (Prionolabis) vancouverensis is very different from all hitherto described American species of the subgenus, differing especially in the large size and in the structure of the male hypopygium. In size it rivals the largest eastern North American species, *L. (P.) rufibasis* Osten Sacken. The structure of the inner dististyles and the gonapophyses are distinctive, the latter being most similar to those of the otherwise entirely different *L. (P.) boharti,* sp. n. The specific name, *vancouverensis,* is derived from the Vancouveran (Oregonian) biotic province rather than from any specific locality. This conspicuous and common species had been mis-identified as *L. (P.) cressoni* Alexander and has been distributed to various museums and private students under this latter name.

Limnophila (Prionolabis) boharti Alexander, sp. n.

Size medium (wing, male, under 10 mm.); antennae 13-segmented, short; body black, sparsely pruinose, the surface opaque; halteres yellow; wings relatively broad, pale brown, with a restricted darker brown pattern; male hypopygium with the outer dististyle having a single developed subapical tooth; inner dististyle terminating in a slender straight lobe that bears numerous conspicuous erect setae on its outer portion; gonapophyses slender-stemmed, at apex dilated into a suboval blade that is further produced into a long beak, the whole suggesting the head and beak of a sandpiper.

MALE.—Length about 8.2 - 8.5 mm.; wing 9.4 - 9.6 mm.; antenna about 1.5 mm.

Rostrum black, sparsely pruinose; palpi black. Antennae black throughout, 13-segmented; flagellar segments oval, the outer ones more elongate; terminal segment longer than the penultimate; verticels of outer segments relatively long and conspicuous, subequal in length to the segments. Head black, sparsely pruinose.

Pronotum black, more or less pruinose. Mesonotum uniform black, with a sparse pruinosity to produce an opaque appearance. Pleura black, similarly sparsely pruinose; dorsopleural region black. Halteres uniform yellow. Legs with the coxae black, sparsely pruinose; trochanters dark brown; femora and tibiae obscure yellow to brownish yellow, passing into brownish black at tips; tarsi black; claws small, simple. Wings relatively broad, with a weak brownish tinge; prearcular and costal fields more yellow; a restricted medium brown pattern, including the stigma, origin of *Rs*, cord and outer end of cell *1st M2*; a scarcely evident darkening along vein *Cu*; cell *2nd A* weakly darkened; veins brown, more yellowish in the brightened fields. Venation: R_{2+3+4} variable in length, subequal to the basal section of R_5, in cases a little longer or shorter; cell M_1 subequal to or shorter than its petiole; cell *1st M2* rectangular, with *m-cu* close to midlength of its lower face.

Abdomen black, the surface subnitidous. Male hypopygium with the notch of tergite relatively broad and deep U-shaped; lateral lobes obtuse at tips. Outer dististyle with a single developed denticle back from the more slender apical spine, in cases this tooth more obtuse; outer lobe very low and appressed to the outer face of style. Inner dististyle with a slender straight lobe that bears several unusually long setae on its outer portion; basal part of style a more fleshy lobe with conspicuous erect setae. Gonapophyses pale, slender-stemmed, the apex dilated into a small suboval compressed blade that is further produced into a long, narrow, nearly straight, beaklike portion, the structure more or less suggesting the head and beak of a sandpiper or curlew. Aedeagus strongly compressed-flattened.

HABITAT.—Oregon (Jackson Co.).

HOLOTYPE, ♂, Mount McLoughlin, June 25, 1939 (T. H. G. Aitken & G. E. Bohart). PARATYPES, 2 ♂♂, pinned with the type.

I am very pleased to name this species for Dr. George E. Bohart, to whom I am indebted for several specimens of western Tipulidae. The species is very distinct from all other regional species, especially in the 13-segmented antennae and in the structure of the male hypopygium, notably of the outer and inner dististyles and the gonapophy-

ses. In the Japanese and Chinese fauna, where more than a score of species of *Prionolabis* are found, there are a few species (*harukonis* Alexander, *imanishii* Alexander and *luteibasalis* Alexander) similarly having 13-segmented antennae instead of the normal for the subgenus of 16-segmented. It is strange that in the nearly forty species of *Prionolabis* now known, none has been discovered having an intermediate number of 14 segments or 15 segments.

Hexatoma (Eriocera) mariposa Alexander, sp. n.

Allied to *criophora*; general coloration black, pollinose or pruinose; mesonotal praescutum with the ground color fulvous yellow, with four conspicuous black stripes; first flagellar segment with about fifteen short spinous setae; femora and tibiae reddish yellow, the tips rather narrowly brownish black, the amount subequal on all legs; wings with an unusually strong blackish tinge, especially on the proximal half; stigma dark brown; vein R_{2+3+4} shorter than the basal section of R_5; cell M_1 a little longer than its petiole; abdomen brownish black, the outer sternites more fulvous yellow; ovipositor with elongate dark-colored cerci.

Female.—Length about 25 mm.; wing 17 mm.; antenna about 5.7 mm.

Rostrum black; palpi black. Antennae of moderate length, as shown by the measurements, 11-segmented; scape reddish yellow beneath, more blackened above; scape brownish black; flagellum black, the outer segments a trifle paler; flagellar segments cylindrical; first segment a little less than twice the length of the second, stout, provided with about 15 short spinous setae; succeeding segments progressively more slender. Head dark brown; on either side of the large entire vertical tubercle with a patch of golden yellow setulae, forming conspicuous yellow spots on the anterior orbits.

Pronotum small, brownish black. Mesonotal praescutum with the ground color fulvous yellow, with four conspicuous black stripes, the intermediate pair narrowly united at the cephalic portion of the sclerite; lateral stripes much broader, crossing the suture onto the scutal lobes; extreme lateral border of praescutum infuscated; setae of praescutum abundant, dark-colored; posterior sclerites of notum blackened, sparsely yellow pollinose; scutellum with relatively long and abundant yellow setae. Pleura and pleurotergite brownish black, the dorsal sternopleurite with a large more reddish area; ventral sternopleurite pruinose. Halteres short, stem brown, knob brownish black.

Legs with the coxae gray pruinose; trochanters obscure reddish brown, sparsely pruinose; femora reddish yellow, the tips rather narrowly brownish black, the amount subequal on all legs, on the fore pair including about the distal sixth, on the posterior pair nearly the distal eighth; tibiae yellow, the tips even more narrowly blackened; proximal two tarsal segments obscure yellow, tipped with black; outer tarsal segments uniformly black. Wings with an unusually strong blackish tinge, especially on proximal half, the outer cells with more yellowish brown centers to appear somewhat lighter in color; the dark color, in part, is produced by broad dark seams to the veins; stigma relatively small, oval, dark brown; veins dark brown. Macrotrichia beyond cord on veins R_{2+3}, R_3, R_4 and distal section of R_5; none on any part of *M*, *Cu* or the Anals. Venation: *Sc* long, Sc_1 ending beyond one-third the length of R_{2+3}; R_{2+3+4} short, from two-thirds to three-fourths the length of basal section of R_5; cell M_1 a little longer than its petiole; cell *1st* M_2 relatively small, about as long as vein M_3 beyond it; *m-cu* about twice as long as the distal section of Cu_1.

Abdomen brownish black; basal sternites more or less pruinose, outer sternites more fulvous yellow. Ovipositor with unusually long and conspicuous cerci, blackened at bases, dark liver-brown outwardly.

Habitat.—California (Mariposa Co.).

Holotype, ♀, Mormon Bar, June 6, 1939 (A. Downes).

Hexatoma (Eriocera) mariposa is most closely allied to *H. (E.) eriophora* (Williston), differing especially in the details of coloration, especially of the legs and the unusually heavily darkened wings. It seems very probable that more than a single species has been confused under the name *eriophora*.

Hexatoma (Eriocera) intrita Alexander, sp. n.

Allied to *velveta;* general coloration black, pruinose; antennae with scape and pedicel black; femora yellow, the tips narrowly blackened, on the posterior legs involving about the distal eighth of segment; wings relatively narrow, whitish subhyaline, sparsely patterned with brown, including a conspicuous seam over the cord; macrotrichia of outer veins very sparse or lacking; R_{2+3+4} nearly straight, about twice as long as the basal section of R_5; cell *1st* M_2 long-rectangular, about as long as vein M_{1+2} beyond it; abdomen, including hypopygium, black, sparsely pruinose.

Male.—Length about 11 mm.; wing 11 x 2.6 mm.

Rostrum black, sparsely pruinose; palpi black. Antennae with scape and pedicel black; flagellum broken. Head black, probably pruinose in fresh specimens; eyes relatively small; anterior vertex about three times the diameter of scape.

Pronotum and mesonotum black, discolored and denuded in the unique type, probably heavily gray pruinose and with praescutal stripes in fresh specimens. Pleura black, gray pruinose; dorsopleural membrane dark brown. Halteres with stem buffy yellow, knob dark brown. Legs with coxae black, gray pruinose; trochanters yellow; a single leg (hind) remains; femora yellow, clearest basally, the tips narrowly black, in amount involving only about the distal eighth; tibiae dark brown, tips blackened; tarsi black. Wings relatively narrow, as shown by the measurements; whitish subhyaline, sparsely patterned with brown, including the small oval stigma and a broad seam along the cord; narrower and less conspicuous seams over the outer end of cell *1st M*2 and bordering the longitudinal veins; wing margin narrowly bordered by brown; veins dark brown. Macrotrichia of veins beyond cord very sparse, lacking except for a restricted series on distal section of R_5. Venation: Sc_1 ending about opposite two-fifths the length of R_{2+3+4}, Sc_2 a short distance from its tip; R_{2+3+4} only slightly arcuated to nearly straight, cell R_4 at base correspondingly narrow; R_{2+3+4} nearly twice the basal section of R_5; cell *1st M*2 long-rectangular, only slightly widened outwardly, subequal in length to vein M_{1+2} beyond it; *m-cu* nearly one-half its length beyond the fork of *M*.

Abdomen black, sparsely pruinose; pleural membrane slightly paler; hypopygium black.

Habitat.—Washington (Walla Walla Co.).

Holotype, ♂, Walla Walla, altitude 1,000 feet., May 28, 1938 (M. C. Lane).

The nearest described species is *Hexatoma (Eriocera) velveta* (Doane) of the central and southern Rocky Mountain region. This is most readily told by the different pattern and venation of the wings and by the increased amount of black on the tips of the femora.

Hexatoma (Eriocera) azrael Alexander, sp. n.

Allied to *austera*; general coloration black, sparsely pruinose; praescutum with three conspicuous black stripes; antennae black, 7-segmented in male, 9-segmented in female, short in both sexes; halteres black; wings with a strong brownish tinge, unpatterned except for the slightly darker stigma; abdomen, including hypopygium, black; male

hypopygium of moderate size, without spinous setae on outer faces of basistyles.

Male.—Length about 7 - 7.2 mm.; wing 7.5 - 8 mm.; antenna about 2 mm.

Female.—Length about 8 mm.; wing 8.2 mm.; antenna about 2 mm.

Rostrum and palpi black. Antennae short in both sexes, 7-segmented in male, 9-segmented in female; black, the scape more or less pruinose; in male, first flagellar segment longer and stouter than the others, about equal in length to the combined second and third; terminal segment a little more than one-third the length of the penultimate; first flagellar segment with numerous long setae but with no modified emergence spines; in female, first flagellar segment somewhat less enlarged than in male. Head black, sparsely pruinose, more heavily so on front; anterior vertex broad, about three and one-half times as wide as the diameter of scape.

Pronotum black, pruinose. Mesonotum black, light gray pruinose, the praescutum with three blackened stripes, the broad median one more or less divided by a capillary duller black vitta; praescutal interspaces with sparse and inconspicuous pale setae; actual lobes with darkened centers. Pleura black, gray pruinose, more heavily so on the ventral sclerites; dorsopleural membrane blackened. Halteres relatively short, blackened. Legs with the coxae black, sparsely pruinose; trochanters black; remainder of legs black. Wings with a strong brownish tinge, the centers of some of the cells, especially *R*, paler; a pale streak immediately behind the basal half of vein *1st A*; stigma short-oval, pale brown, a little darker than the ground; veins brownish black. Macrotrichia of veins beyond cord sparse, including a series along most of the outer section of vein R_5. Venation: Sc_1 ending shortly beyond the fork of *Rs*, Sc_2 at its tip; R_{1+2} subequal to R_2, the latter at or just beyond the fork of R_{2+3+4}; cell *1st* M_2 subequal in length to or longer than vein M_{1+2} beyond it; *m-cu* about one-third its length beyond the fork of *M*, subequal to or a little shorter than the distal section of vein Cu_1.

Abdomen, including hypopygium, black, the sternites slightly more opaque. Male hypopygium relatively small, as compared with *austera*, without spinous setae on the outer face of basistyle as in this latter fly. Ovipositor with the valves relatively short and fleshy, especially the cerci which are much shorter than the hypovalvae, truncated at their tips.

HABITAT.—California (Nevada Co.).

HOLOTYPE, ♂, Cisco, June 13, 1939 (Mont Cazier). ALLOTOPOTYPE, ♀, pinned with the type. PARATOPOTYPE, ♂.

Hexatoma (Eriocera) azrael is readily told from *H.* (*E.*) *parva* (Doane) by the larger size and details of coloration, as the uniformly blackened halteres. I am not fully convinced of the specific distinctness of *parva* from *H. (E.) austera* (Doane). Venation in species of this group is surprisingly variable and can be relied upon only within very restricted limits.

Insect Food of the Western Meadowlark

The present study of the insect food of the western meadowlark, *Sturnella neglecta* Audubon, further emphasizes its value to agriculture and its help in suppressing range insect pests in Utah. The following report is based on an examination of the stomach contents of 172 specimens collected in Utah during the eleven seasons 1932 through 1942, inclusive. Table 1 was prepared to indicate the number of recognizable insects present seasonally in the stomachs, arranged under the various insect orders. Fifty-two of the stomachs were collected April through June, 45 during July and August, and 75 in September and October.

Insect material still recognizable in the stomachs included: 242 adult and 92 nymphal grasshoppers, *Melanoplus mexicanus* Saus. being most frequently recognizable, besides 41 grasshopper eggs, doubtless digested from female abdomens; 14 Mormon cricket nymphs, *Anabrus simplex* Hald., 1 snowy tree cricket, *Oecanthus niveus* (De G.), 2 Jerusalem crickets, *Stenopelmatus longispina* Brunner, 1 coulee cricket, and 1 phasmid. Neuroptera recognized were 2 raphidids and 2 mantispids. Odonata, 2 dragonflies and 1 damselfly. Hemiptera included among the Lygaeidae, 41 false chinch bugs, *Nysius ericae* (Sch.), 1 *Lygaeus kalmii* Stal, 1 *Ligyrocoris nitidulus* (Uhl.), and 2 *Corizus hyalinus* Uhl.; the 42 Pentatomidae included 3 *Acrosternum hilaris* (Say), 11 *Brachymena sulcata* Van D., 2 *Chlorochroa uhleri* Stal, 7 *C. sayi* Stal, 2 *Euschista inflatus* Van D., 4 *Thyanta custator* (Fabr.); 3 Reduviidae included one *Reduvius personatus* (L.) and 1 *Sinea diadema* (Fabr.); among the Miridae were 4 *Lygus hesperus* Knight and 6 *L. elisus* Van D.; Coreidae, 1 *Carpocorus remota* Horv., 1 *Leptocoris trivittatus* Say, and 1 *Peribalus limbolarius* Stal; one Neididae; 6 Scutelleridae included 2 *Homaemus aeneifrons* (Say). Among the Homoptera were 14 sugar-beet leafhoppers, *Eutettix tenellus* (Baker), one *Oncometopius lateralis* (Fabr.), and 11 pea aphids, *Macrosiphum pisi* (Kalt.). Coleoptera included 1 Gyrinidae, 105 Carabidae, 6 Silphidae of which 2 were *Silpha lapponica* Hbst.; 5 Staphylinidae; of the 4 Meloidae 1 was *Epicauta pennsylvanica* (De G.); 12 Elateridae, 1 a wireworm; 4 Buprestidae; 73 Dermestidae included 48 larvae, 1 adult *Dermestes frischi* Kug., 1 *D. marmoratus* Say, 1 *D. talpinus* Mann. and 3 *D. lardarius* L.; 20 Tenebrionidae; of 33 Scarabaeidae, 21 were of the genus *Aphodius*, mostly *Aphodius granarius* (L.) and *A. distinctus* Mull.; 1 Histeridae; 1 Lucanidae; 2 Cerambycidae; of 26 Chrysomelidae, 2 were larvae and 1 an adult asparagus beetle, *Crioceras asparagi* (L.) and 1 *Disonycha pennsylvanica* (Ill.); 3 Mylabridae, pea weevils, *Bruchus pisorum* (L.); 76 Curculionidae included 7 adult and 19 larval clover leaf weevils, *Hypera punctata* (Fabr.), 38 adult and 6 larval alfalfa weevils, *Phytonomus posticus* (Gyll.), and 7 strawberry root weevils, *Brachyrhinus ovatus* (L.) and *B. rugosostriatus* Goeze.

Lepidoptera included 13 beet webworms, *Loxostege sticticalis* L., of the family Pyralidae; of 223 specimens that appeared to be Phalaenidae larvae, at least 54 were army cutworms, *Chorizagrotis auxilaris* (Grote) and 1 was a corn earworm, *Heliothis armigera* Hbn.; there were only 9 adult Lepidoptera recognized while 483 larvae were found. Diptera included 1 Tipulidae, 3 Chironomidae, 1 Culicidae, 2 Calliphoridae, and 2 Muscidae. Among recognizable Hymenoptera were 2 Tenthredinidae, 2 Chrysididae, 245 Formicidae, 2 Vespidae, 3 Sphecidae,

4 Andrenidae, 2 Megachilidae and 2 other wild bees. Recognized material other than insects was 36 spiders, 1 mite, 1 sowbug, 1 roundworm, 155 wheat and oat seeds beside numerous sunflower and other weed seeds, the total being 744 seeds; some plant material also was found.—G. F. Knowlton and D. R. Maddock, Utah Agricultural Experiment Station, Logan.

Table 1. Seasonal insect food recognized in 172 western meadowlark stomachs, collected 1932 through 1942.

Order	April, May, June 52 stomachs	July, August 45 stomachs	Sept., Oct. 75 stomachs	Total
Orthoptera	58	180	201	439
Isoptera	3	0	14	17
Neuroptera	1	0	3	4
Odonata	0	3	0	3
Hemiptera	77	56	71	204
Homoptera	13	18	3	34
Coleoptera	417	111	290	818
Trichoptera	0	0	1	1
Lepidoptera	390	58	44	492
Diptera	14	1	18	33
Hymenoptera	107	55	148	310
Total insects	1080	482	793	2355
Spiders and mites	23	5	9	37
Roundworms	1	0	0	1
Seeds of weeds, etc.	14	12	563	589

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